4. DEVELOPMENT OF REMEDIAL ALTERNATIVES

4.1 Introduction

The alternatives presented in the following sections were developed by combining the representative process options (RPOs) identified in Section 3.4 into a range of comprehensive strategies to meet remedial action objectives (RAOs). Because of the limited number of remedial alternatives applicable to the INTEC tank farm site conditions and contaminants of concern (COCs), a preliminary screening of alternatives is not necessary (EPA 1988), and the alternatives developed in this section will be carried directly into detailed analysis.

The effectiveness of Operable Unit (OU) 3-14 remedial alternatives, and potential OU 3-13 Group 4 remedies, with respect to meeting OU 3-14 Snake River Plain Aquifer (SRPA) RAOs I and II was numerically modeled. Results are reported in Appendix A of this feasibility study (FS) and are discussed in Sections 5 and 6. Potential OU 3-13 and OU 3-14 remedies, and several combinations thereof, were simulated. The modeling results indicated that actions on tank farm soil alone will not meet SRPA RAOs; however, reducing recharge of precipitation to 1 mm/yr over a roughly 10-acre area, with the tank farm at the center, would meet SRPA RAOs. All tank farm soil alternatives, with the exception of the limited action alternative, therefore include controlling recharge of precipitation over a 10-acre primary recharge control zone (PRCZ).

The 10-acre PRCZ is covered by a variety of surfaces, including buildings, roads, drainage ditches, soil and gravel, and other surfaces, and infrastructure that may remain in service until INTEC operations end. Reducing recharge over this area to 1 mm/yr is likely not a measurable or attainable goal. Therefore, an area outside the PRCZ, designated the secondary RCZ (SRCZ), will be addressed by OU 3-13 Group 4. The combined recharge control efforts will be designed to achieve an overall reduction in recharge that will meet SRPA RAOs. The areal extent and the recharge control options for the SRCZ will be defined in an Engineering Design File to be prepared by OU 3-13 Group 4. The OU 3-13 and OU 3-14 recharge control efforts will be integrated through the OU 3-14 Record of Decision (ROD).

4.2 Criteria for the Development of Remedial Alternatives

The purpose of the FS and the overall remedy selection process is to identify remedial actions (RAs) that eliminate, reduce, or control risks to human health and the environment (40 CFR 300). The national program goal of the FS process, as defined in the National Contingency Plan (NCP), is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. The NCP defines certain expectations for developing RA alternatives to achieve these goals. The criteria (40 CFR 300.430) used to develop the alternatives are as follows:

- Treatment should be used to address the principal threats by a waste unit, wherever practical. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic or radioactive compounds, and highly mobile materials.

- Engineering controls, such as containment, should be used for waste that poses a relatively low long-term threat or where treatment is impractical.

- A combination of methods, as appropriate, should be used to achieve protection of human health and the environment. In appropriate situations, treatment of principal threats should be combined with engineering and institutional controls for treatment of residuals or untreated waste.

- Institutional controls, such as restrictions on water use, security, fencing, and deed restrictions, should be used to supplement engineering controls for short- and long-term management to prevent or limit exposure to hazardous substances or contaminated environmental media. The use of institutional controls should not substitute for active response measures as the sole remedy unless such active measures are determined not to be practicable.

- Innovative (nondemonstrated) technologies should be considered when such a technology offers comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies.

- Usable groundwaters should be returned to their beneficial uses, where practical, within a timeframe that is reasonable given the particular circumstances of the site. When restoration of groundwater to beneficial uses is not practical, the EPA expects to limit, if possible, migration of the contaminant plume, prevent exposures to contaminated groundwater, and evaluate further risk reduction.

4.3 Applicable or Relevant and Appropriate Requirements

Chemical-, location-, and action-specific applicable or relevant and appropriate requirements (ARARs) are identified in Tables 4-1 through 4-6 by general response action (GRA) and by medium. Preliminary technical and functional requirements (T&FRs) that each alternative must meet are derived from the ARARs and RAOs in subsequent sections.

These ARARs are an expansion of the ARARs identified in the OU 3-14 Remedial Investigation/Baseline Risk Assessment (RI/BRA) (DOE-NE-ID 2006). The ARARs are based on the FS conceptual design basis discussed in Section 1.3.13, as well as the more technology-specific assumptions listed below:

- For GRAs that involve waste generation, the wastes will be classified as CERCLA wastes generated within the Waste Area Group (WAG) 3 area of contamination (AOC), and land disposal restrictions (LDRs) will not be applicable unless placement is triggered or treatment is performed.

- For GRAs that involve soil removal, soil or debris generated as a result of OU 3-14 activities and transferred for disposal at the Idaho CERCLA Disposal Facility (ICDF) will not be subject to hazardous waste determination requirements (IDAPA 58.01.05.006 [40 CFR 262.11]), LDRs (IDAPA 58.01.05.011 [40 CFR 268]) as cited by IDAPA 58.01.05.011, or alternative LDR treatment standards for contaminated soil (IDAPA 58.01.05.011 [40 CFR 268.49]). This is because the OU 3-14 is within the WAG 3 AOC for purposes of disposal at the ICDF, and the temporary staging of soil prior to transfer to the ICDF will not trigger placement prior to disposal. However, if OU 3-14 wastes require treatment to meet the ICDF Waste Acceptance Criteria (WAC) prior to disposal or if they have been placed, stored, or sent to an off-Site facility for treatment or disposal, then they will be subject to a hazardous waste determination and LDRs as appropriate.

- For GRAs involving management of soil, debris, purge water, drill cuttings, and groundwater treatment process secondary wastes, the risks associated with the Resource Conservation and Recovery Act (RCRA) -regulated chemical constituents in the OU 3-14 soil, perched and aquifer water, and associated drill cuttings were assessed in the RI/BRA. The risk assessment determined that the RCRA-regulated chemical constituents in these materials do not pose an unacceptable risk; therefore, these RCRA-regulated constituents were not identified as COCs. If these waste streams

Table 4-1. Summary of ARARs for OU 3-14 soil GRAs associated with implementation of CERCLA institutional controls, operations and maintenance, and monitoring.

Requirement (Citation)	ARAR Type			Comments
	Action Specific	Chemical Specific	Location Specific	
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to CERCLA—related construction and maintenance activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		Applies to CERCLA-related construction and maintenance activities. The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
40 CFR 61.92, "Standard"		A		Applies to CERCLA-related construction and maintenance activities. Note: This requirement is part of 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities." This standard limits annual emissions of radionuclides to the ambient air to any member of the public to an effective dose equivalent of 10 mrem/yr.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Applies to CERCLA-related construction and maintenance activities.

Table 4-1. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			Applies to CERCLA-related construction and maintenance activities.
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and .651	A			Applies to CERCLA-related construction and maintenance activities.
Idaho Ground Water Quality Rules				
"Ground Water Quality Rule," IDAPA 58.01.11	A			The institutional controls must prevent migration of contaminants from the tank farm soil that would cause the SRPA groundwater to exceed applicable State of Idaho groundwater quality standards in 2095 and beyond.
To-Be-Considered Requirements				
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to tank farm soil during institutional control period. Substantive design and construction requirements will be met to keep public radiation exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE Order 435.1	TBC			Applies to radioactive waste generated from the investigation and remediation activities.
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to tank farm soil during institutional control period, as long as contamination remains in place above levels that allow for unrestricted use and access.

Key:
A = applicable requirement.
TBC = to be considered.

Table 4-2. Summary of ARARs for OU 3-14 soil GRAs including removal and disposal.

Requirement (Citation)	ARAR Type			Comments
	Action Specific	Chemical Specific	Location Specific	
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to remediation activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
40 CFR 61.92, "Standard"		A		Applies to CERCLA-related construction and maintenance activities. Note: This requirement is part of 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities." This standard limits annual emissions of radionuclides to the ambient air to any member of the public to an effective dose equivalent of 10 mrem/yr.
"Toxic Substances," IDAPA 58.01.01.161		A		Applies to remediation activities.
"National Emission Standards for Hazardous Air Pollutants," <10 mrem/yr 40 CFR 61.92, "Standard"		A		Applies to remediation activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Applies to remediation activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			Applies to remediation activities.

Table 4-2. (continued).

Requirement (Citation)	ARAR Type			Comments
	Action Specific	Chemical Specific	Location Specific	
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and .651	A			Applies to remediation activities.
Idaho Hazardous Waste Rules				
"Hazardous Waste Determination," IDAPA 58.01.05.006 (40 CFR 262.11)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
"Temporary Units," IDAPA 58.01.05.008 (40 CFR 264.553)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
"Land Disposal Requirements," IDAPA 58.01.05.011 (40 CFR 268)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
"Alternative LDR Treatment Standards for Contaminated Soil," IDAPA 58.01.05.011 (40 CFR 268.49)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
To-Be-Considered Requirements				
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to tank farm soil remediation. Substantive design and construction requirements will be met to keep public radiation exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE Order 435.1	TBC			Applies to radioactive waste generated from the investigation and remediation activities.
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to tank farm soil during institutional control period, if contamination remains in place after remediation above levels that allow for unrestricted use and access.

Key:
A = applicable requirement.
TBC = to be considered.

Table 4-3. Summary of ARARs for OU 3-14 soil containment GRA.

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to remediation activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
40 CFR 61.92, "Standard"		A		Applies to CERCLA-related construction and maintenance activities. Note: This requirement is part of 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities." This standard limits annual emissions of radionuclides to the ambient air to any member of the public to an effective dose equivalent of 10 mrem/yr.
"National Emission Standards for Hazardous Air Pollutants," <10 mrem/yr 40 CFR 61.92, "Standard"		A		Applies to remediation activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Applies to remediation activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			Applies to remediation activities.

Table 4-3. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and .651	A			Applies to remediation activities.
Idaho Hazardous Waste Rules				
"Hazardous Waste Determination," IDAPA 58.01.05.006 (40 CFR 262.11)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
"Temporary Units," IDAPA 58.01.05.008 (40 CFR 264.553)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
"Land Disposal Requirements," IDAPA 58.01.05.011 (40 CFR 268)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
"Alternative LDR Treatment Standards for Contaminated Soil," IDAPA 58.01.05.011 (40 CFR 268.49)	A			Applies to OU 3-14 soil that has been placed or stored or is being sent to an off-Site facility for treatment or disposal.
Idaho Ground Water Quality Rules				
"Ground Water Quality Rule," IDAPA 58.01.11	A			Controls need to prevent migration of contaminants from the tank farm soil that would cause the SRPA groundwater to exceed applicable State of Idaho groundwater quality standards in 2095 and beyond.
To-Be-Considered Requirements				
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to tank farm remediation. Substantive design and construction requirements will be met to keep public radiation exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE Order 435.1	TBC			Applies to radioactive waste generated from the investigation and remediation activities.

Table 4-3. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to controls on tank farm sites during institutional control period, because contamination will remain in place after remediation above levels that allow for unrestricted use and access.

Key:
A = applicable requirement.
TBC = to be considered.

Table 4-4. Summary of ARARs for OU 3-14 soil in situ treatment GRA.

Requirement (Citation)	ARAR Type			Comments
	Action Specific	Chemical Specific	Location Specific	
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to remediation activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
40 CFR 61.92, "Standard"		A		Applies to CERCLA-related construction and maintenance activities. Note: This requirement is part of 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities." This standard limits annual emissions of radionuclides to the ambient air to any member of the public to an effective dose equivalent of 10 mrem/yr.
"National Emission Standards for Hazardous Air Pollutants," <10 mrem/yr 40 CFR 61.92, "Standard"		A		Applies to remediation activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Applies to remediation activities.

Table 4-4. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
“National Emission Standards for Hazardous Air Pollutants,” 40 CFR 61.94(a), “Compliance and Reporting”	A			Applies to remediation activities.
“Rules for Control of Fugitive Dust,” and “General Rules,” IDAPA 58.01.01.650 and .651	A			Applies to remediation activities.
Idaho Hazardous Waste Rules				
“Hazardous Waste Determination,” IDAPA 58.01.05.006 (40 CFR 262.11)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
“Temporary Units,” IDAPA 58.01.05.008 (40 CFR 264.553)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
“Land Disposal Requirements,” IDAPA 58.01.05.011 (40 CFR 268)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal.
“Alternative LDR Treatment Standards for Contaminated Soil,” IDAPA 58.01.05.011 (40 CFR 268.49)	A			Applies to OU 3-14 soil that has been placed or stored or is being sent to an off-Site facility for treatment or disposal.
To-Be-Considered Requirements				
“Radiation Protection of the Public and the Environment,” DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to tank farm soil remediation. Substantive design and construction requirements will be met to keep public radiation exposures as low as reasonably achievable.
“Radioactive Waste Management,” DOE Order 435.1	TBC			Applies to radioactive waste generated from the investigation and remediation activities.
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to the tank farm sites during institutional control period if contamination remains in place after remediation above levels that allow for unrestricted use and access.

Key:
A = applicable requirement.
TBC = to be considered.

Table 4-5. Summary of ARARs for OU 3-14 groundwater GRAs, including the implementation of CERCLA institutional controls, operations and maintenance, and monitoring.

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to remediation activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
40 CFR 61.92, "Standard"		A		Applies to CERCLA-related construction and maintenance activities. Note: This requirement is part of 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities." This standard limits annual emissions of radionuclides to the ambient air to any member of the public to an effective dose equivalent of 10 mrem/yr.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Applies to well construction and maintenance activities.

Table 4-5. (continued).

Requirement (Citation)	ARAR Type			Comments
	Action Specific	Chemical Specific	Location Specific	
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			Applies to well construction and maintenance activities.
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and .651	A			Applies to well construction and maintenance activities.
Idaho Well Construction Standards Rules				
"Construction of Cold Water Wells," IDAPA 37.03.09.025	A			Applies to wells constructed for monitoring or remediation.
Idaho Hazardous Waste Rules				
"Hazardous Waste Determination," 40 CFR 262.11	A			Applies to purge water generated during groundwater sampling activities that will be stored long term or treated.
Idaho Ground Water Quality Rules				
"Ground Water Quality Rule," IDAPA 58.01.11	A			The institutional controls must prevent access to groundwater in the SRPA that exceeds applicable State of Idaho groundwater quality standards.
To-Be-Considered Requirements				
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to groundwater sampling activities. Substantive design and construction requirements will be met to keep public radiation exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE Order 435.1	TBC			Applies to radioactive waste generated from the investigation and remediation activities.
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to that portion of the SRPA that exceeds applicable State of Idaho groundwater quality until concentrations drop below levels that allow for unrestricted use and access.

Key:
A = applicable requirement.
TBC = to be considered.

Table 4-6. Summary of ARARs for INTEC groundwater pumping, treatment, and disposal GRAs.

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to remediation activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
40 CFR 61.92, "Standard"		A		Applies to CERCLA-related construction and maintenance activities. Note: This requirement is part of 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities." This standard limits annual emissions of radionuclides to the ambient air to any member of the public to an effective dose equivalent of 10 mrem/yr.
"National Emission Standards for Hazardous Air Pollutants," <10 mrem/yr 40 CFR 61.92, "Standard"		A		Applies to remediation activities.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Applies to remediation activities.

Table 4-6. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			Applies to remediation activities.
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and .651	A			Applies to remediation activities.
Idaho Department of Water Resources Rules				
"Well Construction Standards Rules," IDAPA 37.03.09	A			Applies to wells constructed for monitoring or remediation.
"Rules and Minimum Standards for the Construction and Use of Injection Wells in the State of Idaho," IDAPA 37.03.03	A			Applies to construction and use of injection wells.
Idaho Hazardous Waste Rules				
"Hazardous Waste Determination," IDAPA 58.01.05.006 (40 CFR 262.11)	A			Applies to OU 3-14 wastes generated during pump and treat remediation activities that are placed, stored, or sent to an off-Site facility for treatment or disposal.
"Hazardous Waste Determination," 40 CFR 262.11	A	A		Applies to wastes that are generated during pump and treat remediation activities and will be stored long term or treated.
Idaho Ground Water Quality Rules				
"Groundwater Quality Rule," IDAPA 58.01.11	A			The applicable State of Idaho groundwater quality standards must be met by 2095 and thereafter.
To-Be-Considered Requirements				
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to groundwater sampling activities. Substantive design and construction requirements will be met to keep public radiation exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE Order 435.1	TBC			Applies to radioactive waste generated from the investigation and remediation activities.

Table 4-6. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to that portion of the SRPA that exceeds applicable State of Idaho groundwater quality until concentrations drop below levels that allow for unrestricted use and access.

Key:
A = applicable requirement.
TBC = to be considered.

are generated for purposes of management of the remediation waste within the WAG 3 AOC, they will be managed as a waste that no longer contains RCRA hazardous constituents at concentrations that would cause an unacceptable risk from these constituents.

- For soil containment GRAs, RCRA requirements for final closure caps will apply only if portions of the RCRA-regulated system in the tank farm will not be clean-closed (i.e., left in place with concentrations of RCRA constituents that would cause an unacceptable risk). Currently, the tank farm system (tanks, piping, and sand pads) are undergoing a phased RCRA closure. Based on the ability of this phased closure to successfully remove the RCRA-regulated constituents to acceptable levels, it is assumed that the tank farm will be clean-closed under RCRA. Although RCRA hazardous wastes were associated with the liquids released to soil at the tank farm, the concentrations of the hazardous waste constituents found in the tank farm soil are below the levels that would cause unacceptable risks and thereby trigger requirements for a RCRA-compliant cap and associated RCRA groundwater monitoring systems. However, an engineered cap is a viable remedial alternative to reduce exposure to or migration of radionuclides, in combination with a monitoring system to assess radionuclide contamination trends in groundwater.

- For groundwater treatment GRAs, all secondary wastes are assumed to meet the ICDF WAC due to the very low radionuclide concentrations in groundwater that might be removed and concentrated during treatment. This assumption would also apply to the WAC for any off-Site disposal facility that might be used after ICDF closes.

- RCRA postclosure monitoring is not required as part of any OU 3-14 final remedy, based on the assumption of clean-closure of the tank farm system and absence of hazardous constituents in soil at concentrations above risk-based levels.

- For alternatives involving containment, an assumption is that wastes other than secondary wastes incidental to capping will not be generated because the contaminated soil would not be disturbed during containment activities.

- For alternatives involving in situ grouting, an assumption is that wastes other than secondary wastes incidental to grouting will not be generated.

4.4 Description of OU 3-14 Remedial Alternatives

RPOs selected in Section 3.4 were combined to formulate a range of comprehensive remedial alternatives to satisfy the RAOs and ARARs for OU 3-14 soil and the SRPA. Alternatives are summarized in Table 4-7 and are discussed below. Preliminary technical and functional requirements for each element of each alternative are identified, based on the RAOs and ARARs identified previously, as well as other considerations. Requirements are identified to produce adequate conceptual designs for detailed and comparative analysis in Sections 5 and 6, respectively. The requirements would be further developed and revised during remedial design (RD).

Figure 4-1 shows the tank farm area, including existing infrastructure, infrastructure planned to be removed from service by 2012, and infrastructure planned to be removed from service by 2035. Current long-term plans are for the CPP-604 building, including Tanks WM-100, WM-101, WM-102, WL-101, WL-102 and WL-133, to remain in service beyond 2012 to support the process equipment waste (PEW) and high-level waste (HLW) evaporators, and the Integrated Waste Treatment Unit. Future project schedules and details, such as which process lines to continue using or to reroute, are subject to review and change.

Table 4-7. Alternative formulation for OU 3-14.

Alternative/Grouping or Area[a]	Remedy Components: ICs	O&M of TFIA	Monitoring	Low Permeability Asphalt Cap for Infiltration Control		ET/Capillary/ Biobarrier Cap for Worker Protection		Excavation and Disposal		In Situ Grouting		Pump and Treat and Disposal
Alternative 1												
North perimeter TF area, Central TF area, CPP-31, South perimeter TF area	I	I	I									
PRCZ outside TF												
CPP-15	I	I	I									
CPP-58												
SRPA	I		I									
Alternative 2				**2a**	**2b**	**2a**	**2b**	**2a**	**2b**	**2a**	**2b**	
North perimeter TF area	I	I	I	I	I		II[b]	I	I			
Central TF area					I	I	II					
CPP-31					I	I	II					
South perimeter TF area				I	I	II	II					
PRCZ outside TF				I	I		II[b]					
CPP-15	I	I	I	II	II		II[b]					
CPP-58				I	I		II[b]					
SRPA	I		I									
Alternative 3				**3a**	**3b**	**3a**	**3b**	**3a**	**3b**	**3a**	**3b**	
North perimeter TF area	I	I	I	I	I		II[b]	I	I			
Central TF area					I	I	II					
CPP-31					I	I	II	I	II			
South perimeter TF area				I	I	II	II					
PRCZ outside TF				I	I		II[b]					
CPP-15	I	I	I	II	II		II[b]					
CPP-58				I	I		II[b]					
SRPA	I		I									
Alternative 4				**4a**	**4b**	**4a**	**4b**	**4a**	**4b**	**4a**	**4b**	
North perimeter TF area	I	I	I	I	I		II[b]	I	I			
Central TF area					I	I	II					
CPP-31					I	I	II			I	II	
South perimeter TF area				I	I	II	II					
PRCZ outside TF				I	I		II[b]					
CPP-15	I	I	I	II	II		II[b]					
CPP-58				I	I		II[b]					
SRPA	I		I									
Alternative 5	Alternative 5 contingent remedy could be invoked in the future for Alternatives 2, 3, or 4.											
SRPA												II date TBD

ET = evapotranspiration, ICs = institutional controls, O&M = operations and maintenance, PRCZ = primary recharge control zone, TF = tank farm, TFIA = Tank Farm Interim Action.
I = remedy component completed during Phase I (INTEC operations);
II = remedy component completed during Phase II after end of INTEC operations (estimated date 2035); II date TBD = contingent remedy component based on monitoring results (estimated date 2077)
a. See Figure 4-1 for CPP-31 location and Figure 4-2 for location of other areas within the PRCZ.
b. Need determined based on engineering evaluation in the Phase II RD/RA Work Plan.

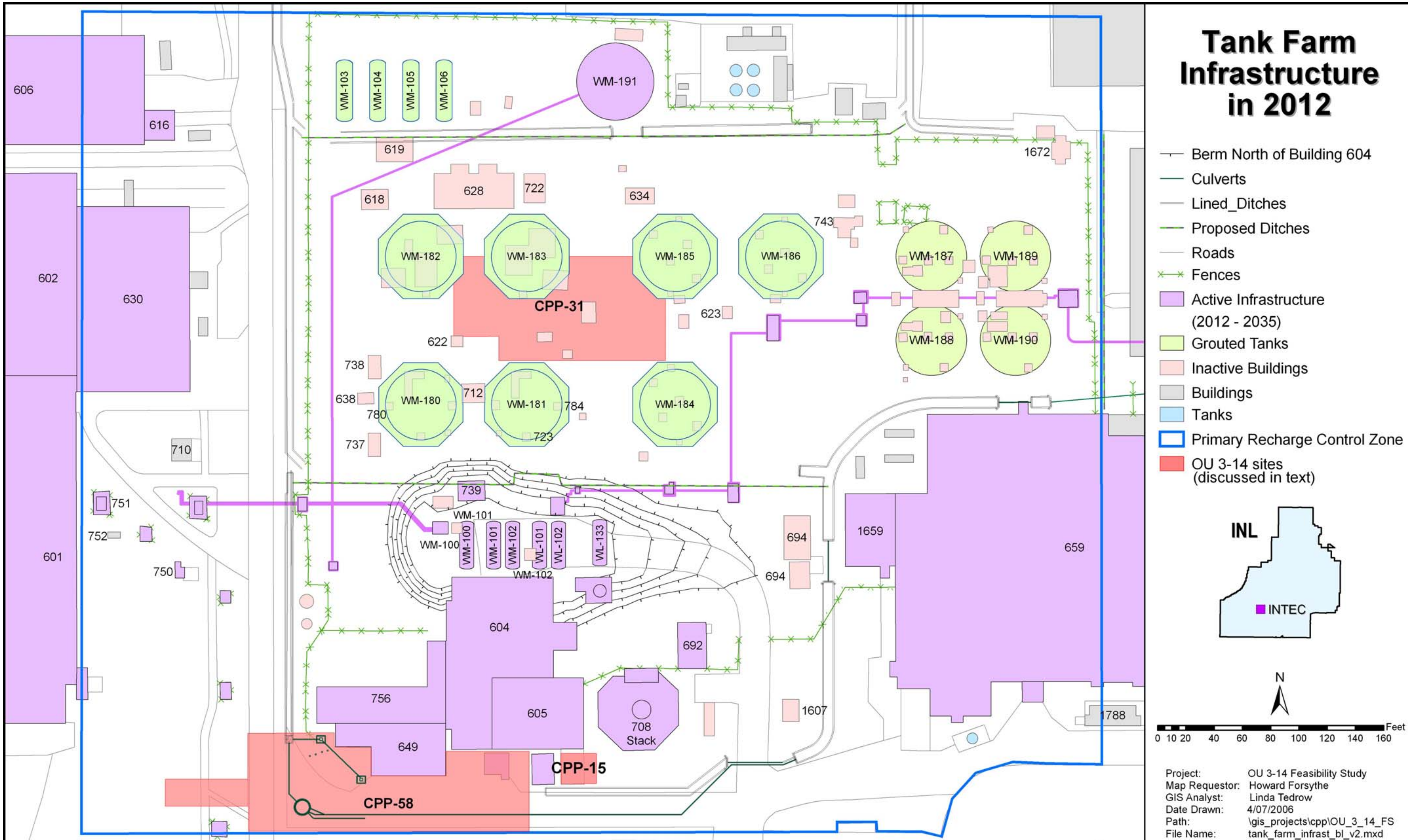


Figure 4-1. Planned configuration of tank farm infrastructure in 2012.

Figure 4-2 shows tank farm north and south perimeter areas, the central tank farm area, and the PRCZ. Alternatives 2a, 3a, and 4a are based on assumptions that Tanks WM-180 through -190 will be cleaned and grouted by 2012, that surface infrastructure in the central tank farm will be leveled to grade or otherwise modified for continued use before cap construction, that continued use of Building CPP-604 will preclude implementing a final worker protection cap over the south tank farm perimeter area until INTEC operations end in 2035, and that continued INTEC operations will not otherwise interfere with implementation of a final OU 3-14 remedy.

Alternatives 2b, 3b, and 4b are based on the possibility that ongoing or new INTEC operations projected to continue through 2035 may not allow for complete implementation of the final remedy prior to that time. Under these alternatives, the north, central, and south tank farm areas would be paved with low-permeability asphalt capping to control recharge, pending implementation of an evapotranspiration (ET) cap with a capillary/biobarrier by 2035 over the central and south areas.

Alternative 5 provides for the contingency that groundwater pumping and treatment may be required to meet RAO II. Alternative 5 is presented as a separate alternative; however, it would only be implemented after an OU 3-14 alternative, including groundwater monitoring, and OU 3-13 Group 4 remedies had been implemented and determined to not meet RAO II.

Each of these alternatives, and a limited action alternative, are described below in detail.

4.4.1 Alternative 1—Limited Action

Formulation of a No Action alternative is required by the NCP (40 CFR 300.430(e)(6)) and guidance for conducting feasibility studies under CERCLA (EPA 1988). The No Action alternative serves as a baseline for evaluation of other RA alternatives and is generally retained throughout the FS process. As defined in the CERCLA guidance (EPA 1988), a No Action alternative may include environmental monitoring; however, actions taken to reduce exposure, such as site fencing or deed restrictions, are not included as a component of the No Action alternative.

Because the INTEC tank farm is projected to continue operations until at least 2035 and is proposed to remain a restricted, industrial-use area, including access restrictions and site fencing, until 2095, a "true" No Action alternative cannot be developed for OU 3-14. Therefore, Alternative 1, Limited Action, will serve as a basis of comparison against the other alternatives developed in this FS.

Alternative 1 includes the following:

- OU 3-14 soil and SRPA institutional controls
- Operation and maintenance (O&M) of existing surface water controls implemented under the Tank Farm Interim Action (TFIA)
- Postclosure monitoring of OU 3-14 soil until 2095
- Monitoring the SRPA until 2095.

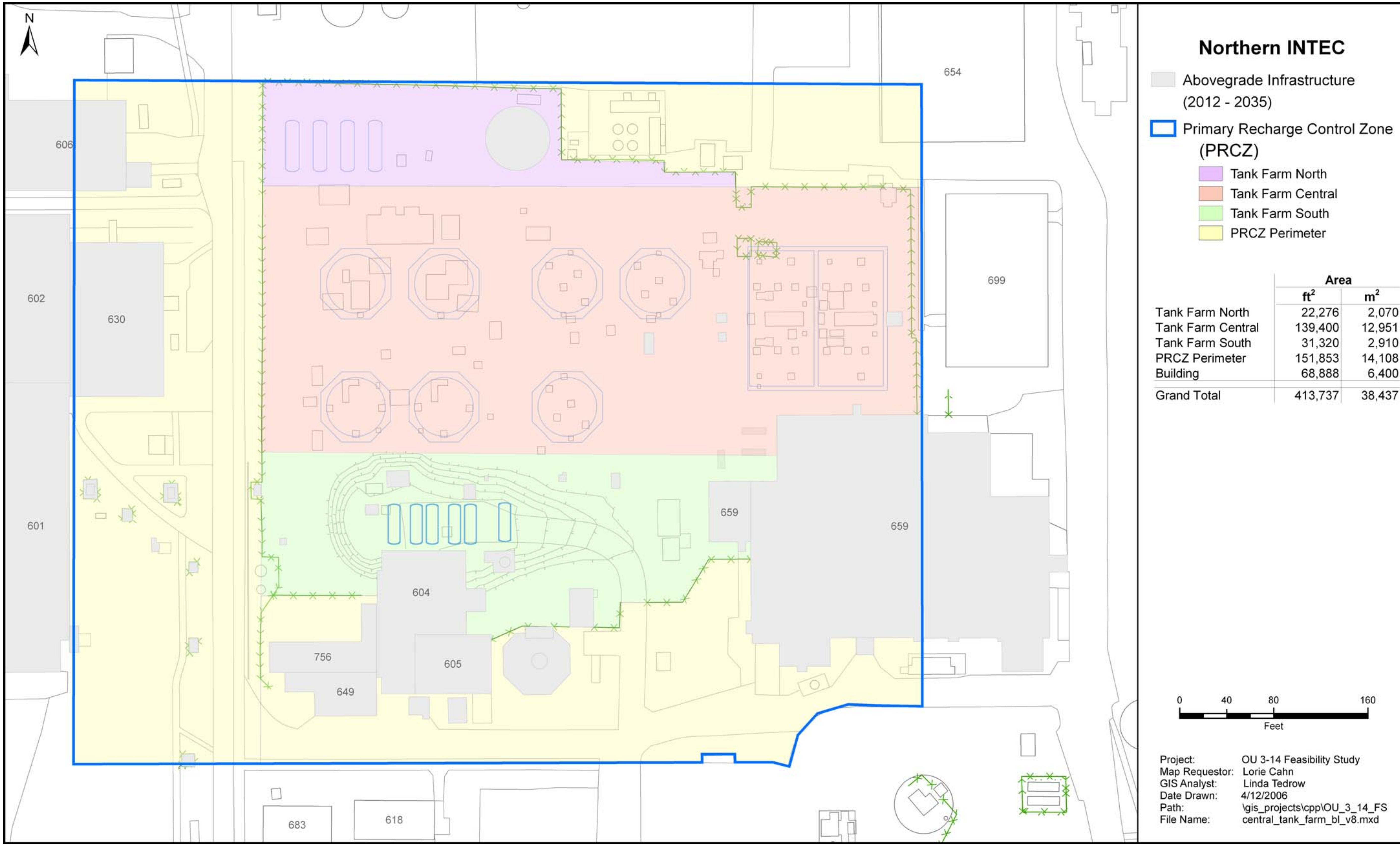


Figure 4-2. Tank farm areas and PRCZ.

4.4.1.1 Institutional Controls. Existing institutional controls will remain in effect as long as hazards remain that limit unrestricted use of the site for the planned land use, through at least 2095. Institutional controls identified as part of Alternative 1 for tank farm soil include the following:

- Control of activities
  - Maintain the site listings and updates in the INL Comprehensive Facilities and Land Use Plan (CFLUP); update changes or terminations agreed to by the Agencies.
  - Provide public notices to stakeholders of changes in institutional controls.
  - Add new DOE directives, new DOE orders, or changes to List B of the O&M contract as they occur.
  - Control use of water via well-drilling restrictions or easements for monitoring, restrictive covenants, or land withdrawal documentation that would be deemed necessary to further protect the public and the environment if land use or ownership changes.
  - Maintain work control process under 10 CFR 835 and DOE G 441.1-12
  - Restrict and/or control soil disturbances to eliminate potential spread of contamination.
- Access restrictions
  - Post and maintain visible access restrictions.
  - Control access as follows:
    - Maintain INL Site access controls under DOE O 470.4, "Safeguards and Security Program."
    - Maintain physical tank farm site access controls, including warning signs, fences, barriers, and boundary markers; and administrative controls, including radiological work permits (RWPs) and personnel training.
- Maintain restrictions on leasing or transferring property.
- Maintain notification requirements in response to failed controls/corrective action.

Because contaminants will remain at CPP-96 at concentrations that pose a risk under this alternative, a 5-year site review is required by the NCP (40 CFR 300.430(f)(4)(ii)). Five-year reviews will be conducted to evaluate the effectiveness of the existing institutional controls alternative, to evaluate the need for its continuation, or to consider a different alternative.

Institutional controls identified as part of Alternative 1 for the SRPA include the following:

- Access restrictions as described previously
- Control of activities as described previously
- Restrictions on leasing or transferring property as described previously
- 5-year reviews as described previously.

4.4.1.2 Monitoring.
Monitoring for tank farm soil includes radiation surveys at the tank farm fenceline and environmental monitoring. Monitoring of existing SRPA wells that is currently addressed under OU 3-13, Group 5, would be continued under OU 3-14. No new wells are included under this alternative.

4.4.1.3 Operations and Maintenance.
Annual O&M activities for tank farm soil institutional controls were estimated from planned activities for OU 3-13, Group 3, sites as follows:

- Annual replacement of 10% of all signs (signs have an expected lifespan of 10 years)
- Annual inspection of all of CPP-96, including all institutional control signs.
- Inspection report for CPP-96
- Update of the CFLUP for CPP-96.

O&M for the TFIA as described in DOE-ID (2005a) includes the following:

- Inspection and repair as needed of asphalt areas
- Inspection, clearing, and repair of discharge pipes, culverts, and storm drains
- Inspection, maintenance, and repair of the lift station
- Inspection and repair of the evaporation pond and sediment removal, as required, and disposal in the ICDF or an equivalent on-Site or off-Site facility after ICDF closes.

O&M for existing SRPA monitoring wells are addressed under OU 3-13, Group 5, and are not included here.

4.4.2 Alternative 2a—Institutional Controls, Monitoring, Excavation and Containment by 2012

Alternative 2a is based on an assumption that Tanks WM-180 through -190 will be cleaned and grouted prior to implementing the alternative in 2012, that surface infrastructure in the central tank farm will be leveled to grade or otherwise modified for continued use after capping, that continued use of Building CPP-604 will preclude implementing a final worker protection cap over the south tank farm perimeter area until INTEC operations end in 2035, and that continued INTEC operations will not otherwise interfere with implementation of a final OU 3-14 remedy. Alternative 2a consists of the following:

- Modifying infrastructure, including constructing retaining walls and demolishing buildings, as discussed in below
- Capping the central tank farm area shown in Figure 4-2 with a minimum 4-ft-thick ET soil cover with a capillary/biobarrier as shown in Figure 4-3
- Characterizing the tank farm north perimeter area for Cs-137, removing soil contaminated above the future worker PRG to a maximum depth of 4 ft, disposing of excavated soil at ICDF, and paving with a low-permeability asphalt cover as shown on Figure 4-4

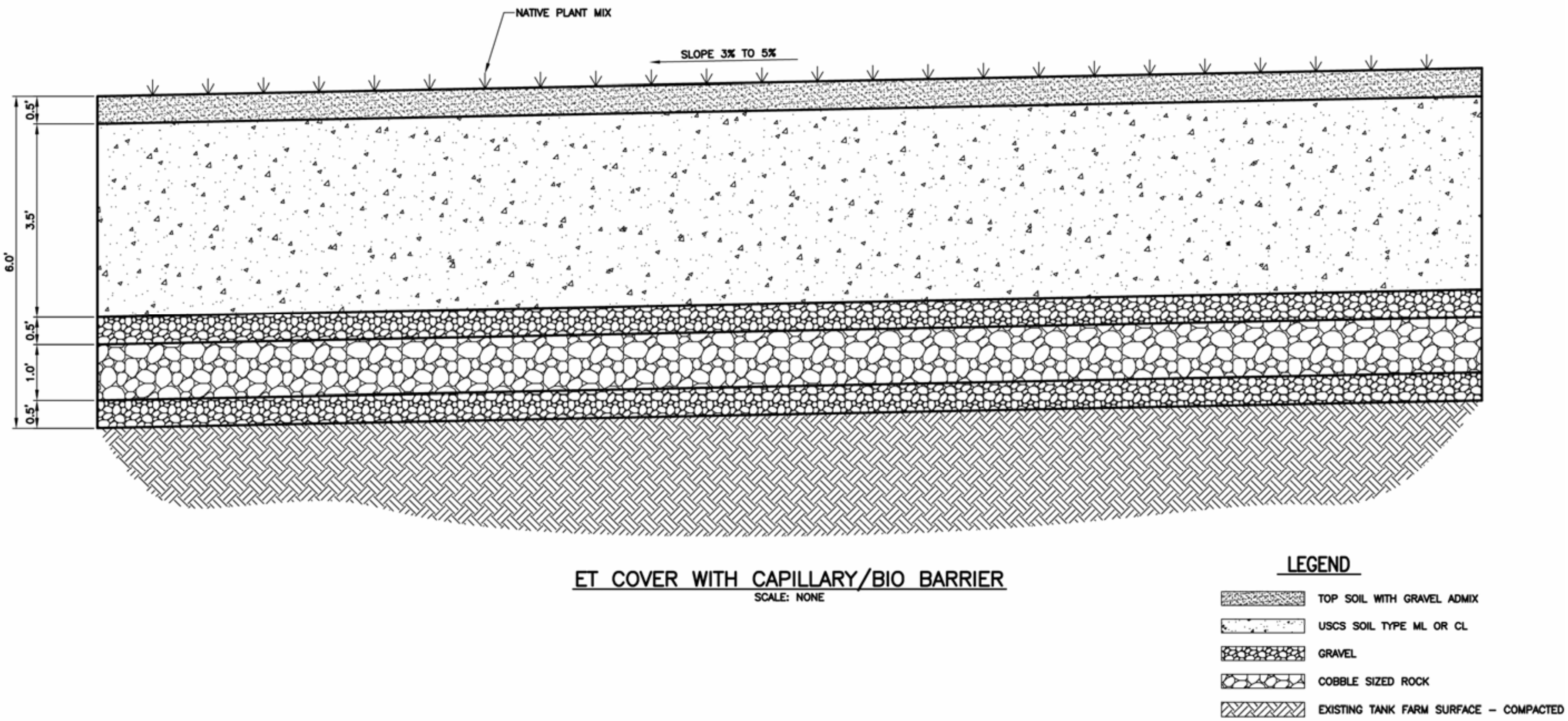


Figure 4-3. Conceptual design for an ET soil cover with a capillary/biobarrier.

- Capping the south tank farm perimeter area adjacent to Building CPP-604 shown on Figure 4-2 with a low-permeability asphalt cover and adding a minimum 4-ft-thick ET soil cover with a capillary/biobarrier by 2035

- Removing existing pavement and paving the portions of the PRCZ outside the tank farm shown in Figure 4-1 with low-permeability asphalt

- Paving CPP-58 with low-permeability asphalt

- Maintaining the concrete transformer pad at CPP-15 as part of the capped area

- Maintaining the low-permeability pavement, the existing lined drainage ditches, the existing evaporation pond, and the existing lift station until at least 2095

- Postclosure monitoring of the CPP-96 area, including the closure covers until 2095

- Monitoring the SRPA until 2095 as described for Alternative 1

- Implementing the CPP-96 and SRPA institutional controls as described for Alternative 1.

Figures 4-5 and 4-6 show the configurations of the capping components of Alternative 2a in 2012 and 2035, respectively. Requirements, conceptual designs, and sequence of activities for each element of Alternative 2a are discussed below in detail. O&M and monitoring of the overall alternative are discussed in Sections 4.4.2.5 and 4.4.2.6, respectively.

4.4.2.1 Institutional Controls. Existing institutional controls will remain in effect as long as hazards remain that make the site unsuitable for unrestricted industrial use, through at least 2095. Institutional controls identified as part of Alternative 2a for tank farm soil include the following:

- Continue control of activities as described previously for Alternative 1

- Maintain access restrictions as described previously for Alternative 1

- Maintain restrictions on leasing or transferring property as described previously for Alternative 1

- Maintain notification requirements in response to failed controls/corrective action as described previously for Alternative 1.

Because contaminants will remain at tank farm at concentrations that pose a risk under Alternative 2, a 5-year site review is required by the NCP [40 CFR 300.430(f)(4)(ii)]. Five-year reviews could be conducted until 2095 to evaluate the effectiveness of the institutional controls, to evaluate the need for its continuation, or to consider a different alternative.

Institutional controls identified as part of Alternative 2 for the SRPA include the following:

- Control access restrictions as described previously for Alternative 1

- Maintain control of activities as described previously for Alternative 1

- Maintain restrictions on leasing or transferring property as described previously for Alternative 1.

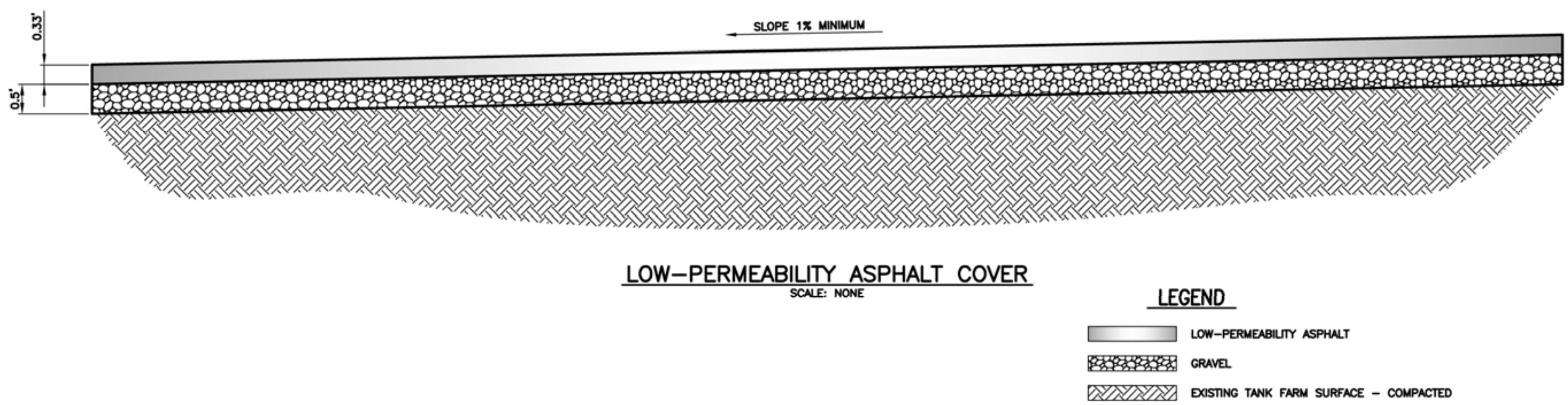


Figure 4-4. Conceptual design for a low-permeability asphalt cover.

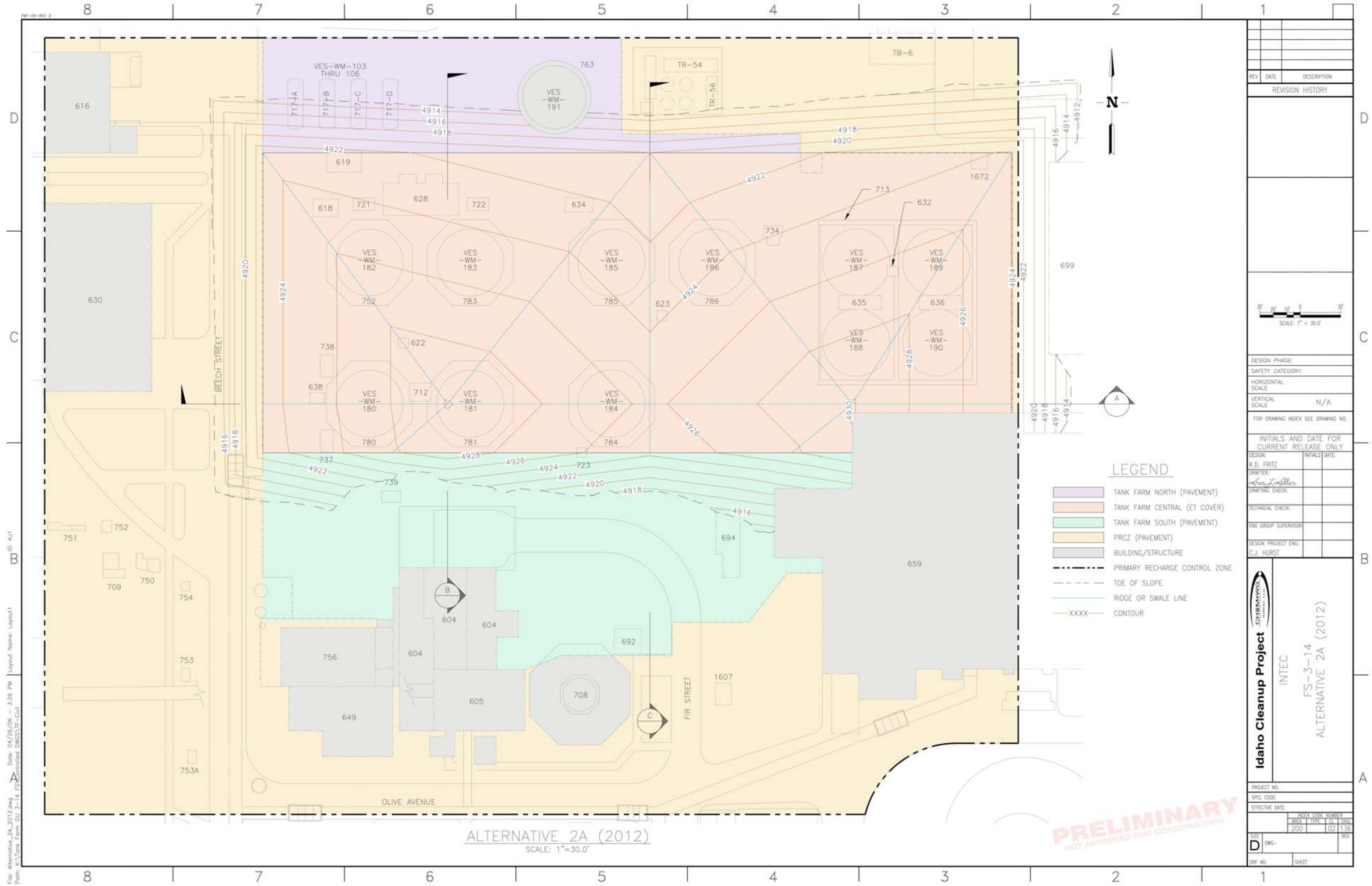


Figure 4-5. Alternative 2a configuration in 2012.

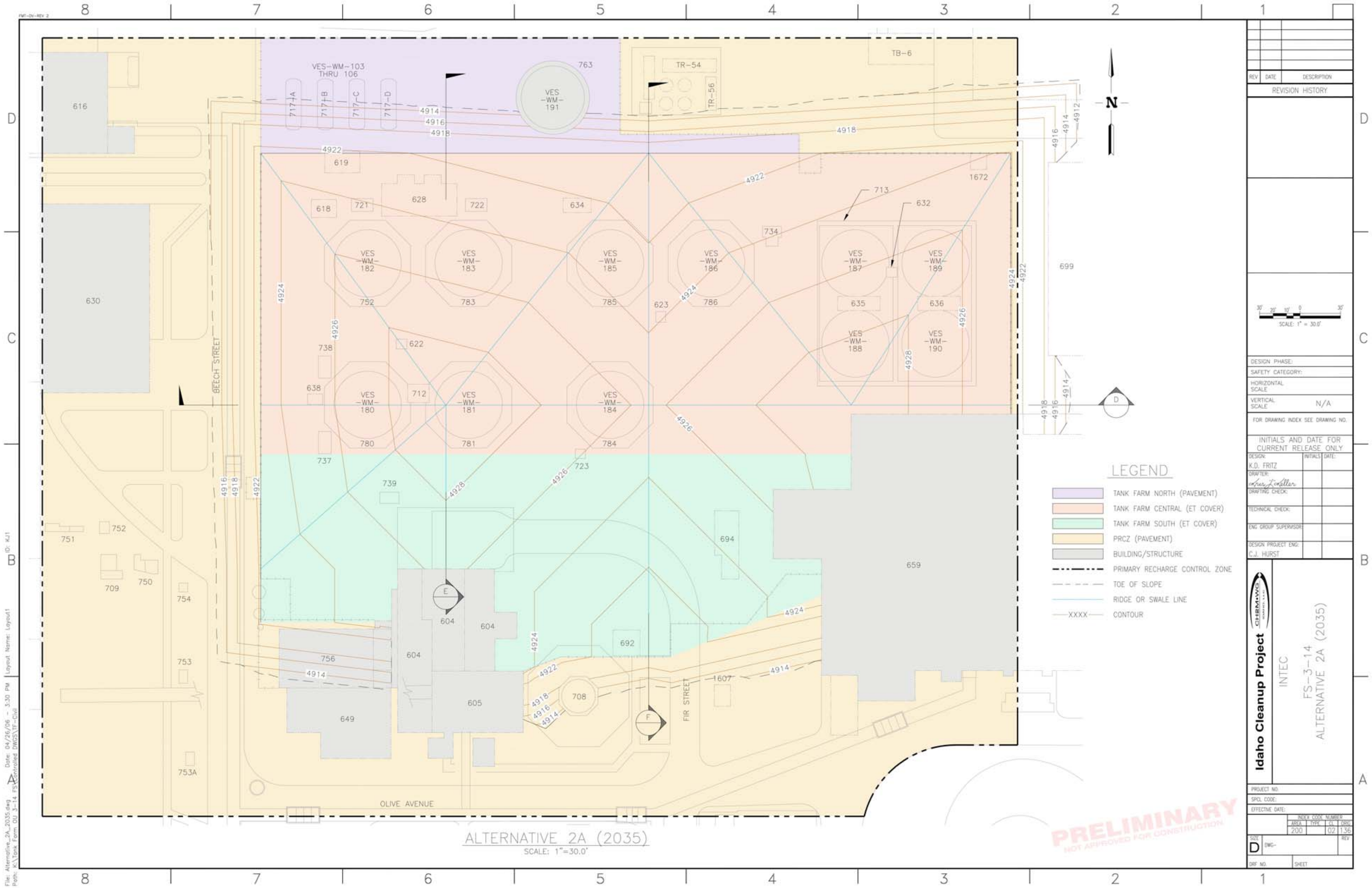


Figure 4-6. Alternative 2a configuration in 2035.

4.4.2.2 ET Cover. As shown in Table 4-7, under Alternative 2a, an ET cover with a capillary/barrier would be constructed over the central tank farm by 2012. The south perimeter area would be capped with an ET cover with a capillary/biobarrier by 2035 when INTEC operations are assumed to end, as shown in Figure 4-6. Cross-section views of the ET cover for Alternative 2a (2012) and Alternative 2a (2035) are given in Figures 4-7 and 4-8. Requirements that must be met by the ET cap with a capillary/biobarrier, a conceptual design to meet the requirements, and a sequence of activities required for implementation are presented below.

4.4.2.2.1 Requirements—Requirements for the ET cap with a capillary/biobarrier were derived from ARARs, TBCs, and RAOs identified previously and best management and engineering practices (BMEPs) related to capping as follows:

1. Soil cover design and implementation must meet the constraints of the tank farm closure schedule as discussed in Section 1.3.6.
    a. Basis: BMEP, technical implementability.
2. Tanks WM-180 through WM-190 must be grouted and tank farm loading restrictions removed prior to constructing the ET cap with a capillary/biobarrier.
    a. Basis: Tank farm loading restrictions, technical implementability.
3. Abovegrade structures within the area of the ET cap with a capillary/biobarrier shown on Figure 4-2 must be demolished to grade, grouted in place, or modified for continued operations before constructing the ET cap with a capillary/biobarrier. Valve boxes remaining in service must have risers installed to bring the height above the final grade of the cap.
    a. Basis: BMEP, technical implementability, constructability.
4. The ET cap with a capillary/biobarrier must reduce infiltration rates to approximately 1 mm/yr based on modeling results reported in Appendix A.
    a. Basis: RAOs.
5. The ET cap with a capillary/biobarrier must be at least 4 ft thick to reduce the likelihood of future workers encountering contaminated soil.
    a. Basis: RAOs.
6. The ET cap with a capillary/biobarrier must function with a minimum of maintenance.
    a. Basis: BMEP.
7. The ET cap with a capillary/biobarrier must promote drainage and minimize erosion or abrasion of the cover.
    a. Basis: RAOs, BMEP.

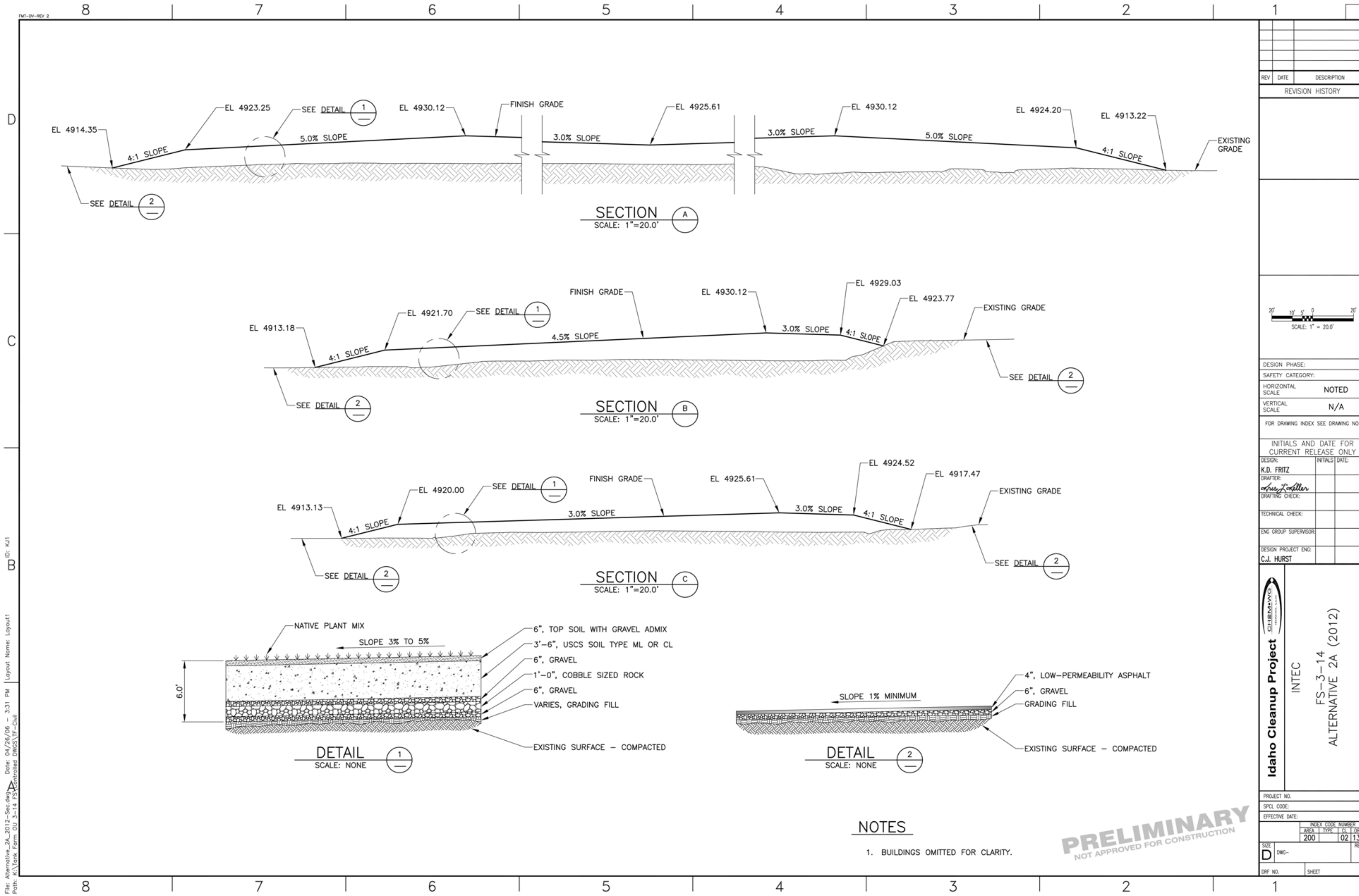


Figure 4-7. Sections views for Alternative 2a in 2012.

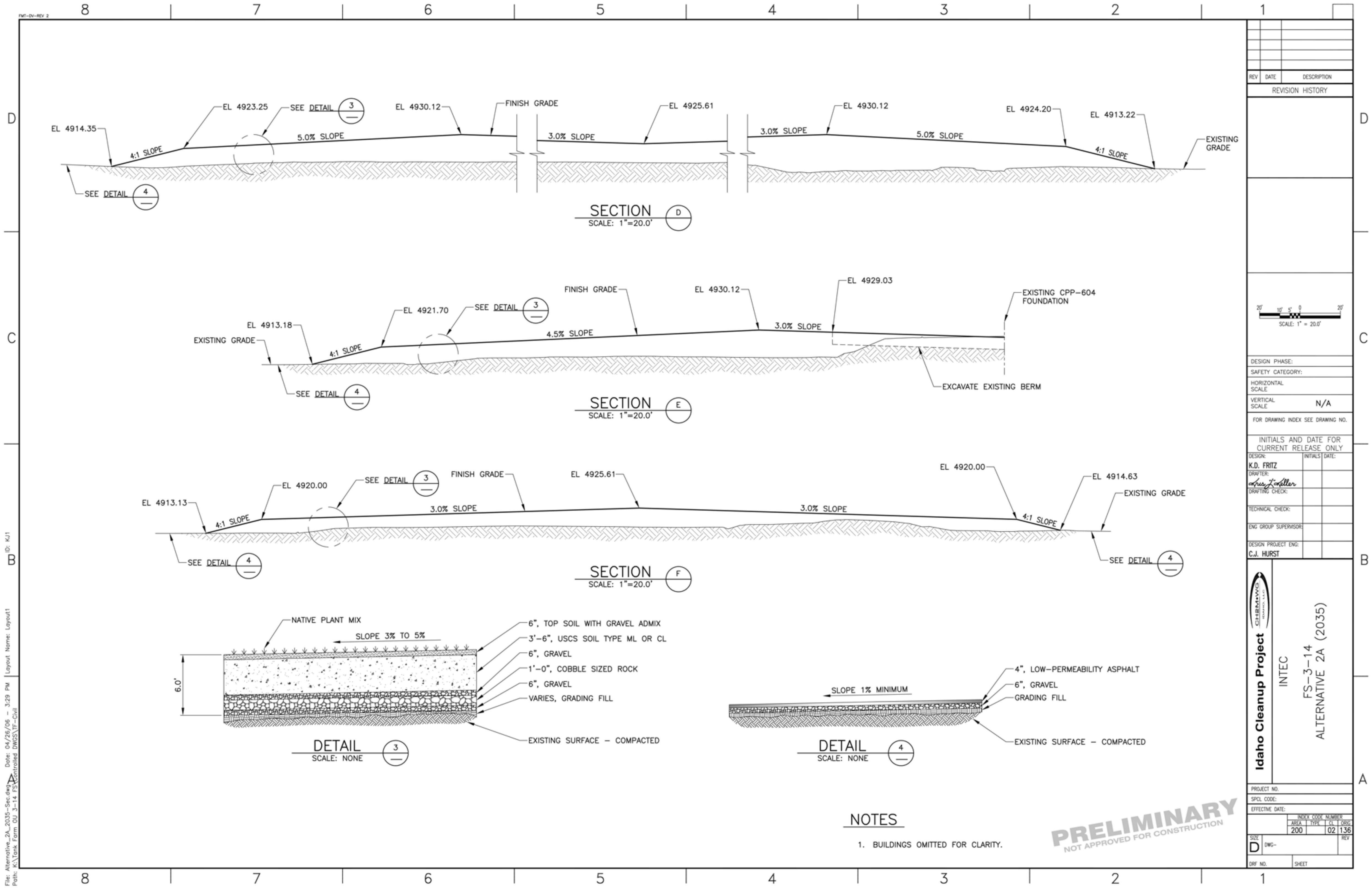


Figure 4-8. Section views for Alternative 2a in 2035.

8. The ET cap with a capillary/biobarrier must accommodate settling and subsidence so that the cover's integrity is maintained.

    a. Basis: RAOs, BMEP.

9. The ET cap with a capillary/biobarrier must be less permeable than underlying subsoil.

    a. Basis: BMEP (avoid "bathtubbing"), RAOs.

10. The ET cap with a capillary/biobarrier must limit exposure to site workers to less than 100 mrem/yr.

    a. Basis: PRD-183, DOE Order 440.1A.

11. The ET cap with a capillary/biobarrier must prevent run-on from damaging the cover or increasing infiltration.

    a. Basis: BMEP, RAOs.

12. The ET cap with a capillary/biobarrier must reduce mobilization of contaminants by plants or burrowing animals.

    a. Basis: BMEP, RAOs.

13. Radiological exposures during construction must be controlled to levels as low as reasonably achievable.

    a. Basis: PRD-183, DOE Order 440.1A, DOE Order 435.1.

14. Fugitive dust emissions must be controlled during construction.

    a. Basis: "Rules for Control of Fugitive Dust" and "General Rules," IDAPA 58.01.01.650 and 58.01.01.651.

15. Emissions of hazardous and toxic pollutants and radionuclides must be controlled during construction.

    a. Basis: Idaho air regulations, IDAPA 58.01.01.161, 58.01.01.585, and 58.01.01.586.

    b. Basis: "National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, 40 CFR 61.94(a).

16. Surface vegetation must be adapted to the climate of the INL Site and representative of the native plant community.

    a. Basis: BMEP, plant health and reproduction to maintain cover integrity.

17. The design life of the cover must be at least 230 years.

    a. Basis: Roughly 230 years are required to reduce Cs-137 soil concentrations to future worker remediation goals by natural radioactive decay.

18. The design environment will include the weather extremes at the INL Site and the soil properties of the tank farm.

    a. Basis: BMEP, meet RAOs and T&FRs for design life.

19. Any geotextiles or other synthetic materials used must have mechanical properties to ensure integrity and functionality under the installation and environmental forces.

    a. Basis: BMEP, design life, design function.

4.4.2.2.2 Conceptual Design—Figure 4-3 shows a cross-sectional view of the ET cap with a capillary/biobarrier designed to meet the previously discussed requirements. The cover design is primarily derived from previous field demonstrations referenced in Section 3 that were shown to meet the requirements.

From the top down, the ET cap with a capillary/biobarrier would consist of the following:

- A native plant mix currently used at the INL Site for revegetating disturbed soil to minimize wind and water erosion and provide transpiration demand on the underlying soil to minimize infiltration of precipitation.

- Six inches of topsoil with a gravel admix to reduce wind and water erosion and improve plant rooting, with a nominal 2 to 5% slope to promote precipitation run-off while minimizing erosion.

- A minimum of 3.5 ft of Unified Soil Classification System (USCS) ML or CL soil, available at a number of INL Site sources, including Rye Grass Flats or the Water Reactor Research Test Facility at Test Area North. This thickness of these soil types provides adequate soil moisture storage for sustaining plants and for storing water during periods when plants are inactive.

- A geotextile or graded filter soil layer to prevent fine-grained soil from entering the underlying capillary barrier.

- 1.0 ft of 3- to 6-in. cobbles or other rock material, also a component of both the capillary barrier and biobarrier.

- Six inches of pea gravel (3/8-in. minus), a component of both the capillary barrier and biobarrier, demonstrated to effectively stop plant roots and burrowing animals in combination with the underlying cobble layer.

The ET cap with a capillary/biobarrier as shown in Figure 4-3 is designed to meet functional requirements to provide a 4-ft-thick minimum clean soil buffer to protect future workers, reduce infiltration to approximately 1 mm/yr, and prevent mobilization of contaminated soil to the surface by plants and animals. The ET cap with a capillary/biobarrier as shown will provide ET demand and storage of precipitation, provided by the vegetative plant cover (a native plant mix) and the water retention characteristics of the 4 ft of topsoil and silt loam, respectively. The soil cover would have gravel admix on the top 6-in. layer of soil to prevent wind and water erosion or abrasion. The surface would be graded to prevent run-on and promote run-off.

The biobarrier design shown in Figure 4-3 was adapted from previous INL Site studies. Gaglio et al. (2001) tested the gravel-cobble-gravel biobarrier, as depicted, for resistance to harvester ant intrusion, at the INL Site. Ants were found not to penetrate the first gravel layer. Keck et al. (1992)

reviewed and summarized many biobarrier studies performed at DOE sites, and the design shown in Figure 4-3 is similar to several of those demonstrated to be effective at arid sites. This biobarrier is expected to resist intrusion by INL Site plants, insects, and burrowing mammals but may be revised during remedial design.

The gravel-cobble-gravel biobarrier will also function as a capillary barrier. Hakonsen (1986) determined that a similar gravel-cobble biobarrier used in closure cover test cell lysimeters at Los Alamos National Laboratory retarded infiltration through the cover and resulted in higher soil moisture contents in the overlying soil relative to designs without a capillary barrier. The effectiveness of the overall design is discussed further in Section 5.

For any capping option to be fully effective, drainage from roofs of any remaining adjacent buildings or structures and run-on from adjacent areas would have to be diverted away from the cap. This would be a requirement of facility operations as long as they continued and would be a requirement of decontamination and decommissioning (D&D) when operations ceased. Structural evaluation of buildings adjoining the ET cap with a capillary/biobarrier, including CPP-659 and CPP-604, and, potentially, Tank WM-191, would be required to determine the bearing strength of the walls to support the earth pressure of the cap.

Soil moisture monitoring instrumentation could be included to measure infiltration control performance. A combination of neutron probe access tubes, tensiometers, psychrometers, time-domain reflectrometry, and other instrumentation could be used.

4.4.2.2.3 Sequence of Activities—Construction would begin with mobilization of subcontractor and Idaho Cleanup Project (ICP) equipment to a staging area. Mobilization activities would include obtaining required equipment and personnel, setting up temporary field trailers, taking delivery of initial materials, and locating and marking underground utilities. Preconstruction meetings and training would be conducted with site workers and subcontractors. Equipment would access the work area by prescribed routes only.

Figure 4-5 shows that significant modifications to existing infrastructure would be required prior to beginning construction of the ET cap with a capillary/biobarrier, including

- Beech Street would be removed from service because the ET cap with a capillary/biobarrier would partially cover the street. No provisions were made in the conceptual design or cost estimates to replace the street.

- Beech Street utility tunnel personnel and maintenance access hatches would be covered by the ET cap with a capillary/biobarrier. No provisions were made in the conceptual design or cost estimates to provide access.

- The Beech Street surface drainage ditch that runs along the western edge of the tank farm would be replaced with a culvert and buried under the ET cap with a capillary/biobarrier. Drainage around the cap perimeter was accounted for in the cost estimates.

- A 10-ft-high retaining wall would be needed to support the ET cap with a capillary/biobarrier that would extend beyond the WM-191 tank. This tank is planned to remain in use through 2035. Construction of the retaining wall was accounted for in the cost estimates

- The ET cap with a capillary/biobarrier extends into CPP-654; therefore, the building would need to be removed. This is an inactive building but is not currently scheduled for D&D. D&D of the building was accounted for in the cost estimates.

- The ET cap with a capillary/biobarrier extends into CPP-699; therefore, the building will need to be removed. This is an inactive building but is not currently scheduled for D&D. D&D of the building was accounted for in the cost estimates.

- A 20-ft-high retaining wall would be needed next to CPP-659 to support the ET cap with a capillary/biobarrier. Construction of the retaining wall was accounted for in the cost estimates.

- The southeast tank farm drainage ditch would be replaced with a culvert and buried under the ET cover. Drainage around the cap perimeter was accounted for in the cost estimates.

- Six valve boxes would need to be extended 10 ft in order to allow access to valves on an active transfer line. Valve box risers were accounted for in the cost estimates.

The design of the ET cap with a capillary/biobarrier could be modified during remedial design to improve implementability in 2012. For example, an area around the perimeter could be excavated to 4 ft below ground surface (bgs) and paved to move the toe of the cap side slopes back from the perimeter. Alternatively, the entire central tank farm could be excavated to 4 ft bgs, prior to constructing the ET cover, to reduce the overall cap height and thereby the conflicts with Building CPP-659, Tank WM-191 and other surface infrastructure. Trade studies during RD could optimize implementation.

The north perimeter area shown in Figure 4-2 would be excavated, backfilled with clean soil and compacted, per the cut and fill and grading plans prepared during RD. Finish grades in the north perimeter areas would be roughly similar to existing, with grading to promote run-off to lined perimeter drains. A surface water drainage plan for the entire PRCZ, prepared during RD, would define required improvements, as well as final grades required in all areas.

Construction of the ET cover with a capillary/biobarrier construction over the central tank farm would begin with preparation of the subgrade. Any remaining surface infrastructure would be removed and grades established per design drawings. The biobarrier/capillary barrier component of the cover would be placed on the subgrade in nominal 6-in. lifts of cobbles and gravels. The rock would be imported, dumped, and placed in a manner similar to the soil layers, but lightly compacted with dozer tracks to set the riprap.

The soil cover overlying the capillary barrier would be constructed in nominal 12-in. lifts. Once roughed into place, soil would be compacted with a sheepsfoot roller pulled behind a dozer or, alternatively, wheel-rolled to avoid overcompaction. Water would be applied as necessary, but, to facilitate plant growth, soil would not be overcompacted. Gravel admix would be applied with the surface soil course and lightly compacted. Figures 4-5 and 4-6 show the final lines and grades for the ET cover with a capillary/biobarrier s in 2012 and 2035, respectively.

The cover surface would be hydroseeded with a native vegetation mix specified for use on disturbed areas at the INL Site. A tackifier would likely be added to the hydroseed mix for establishing vegetation. Compacted or tracked topsoil would be loosened before hydroseeding. Completely covering the disturbed areas with a tackifier and hydroseed would help with dust control until vegetation was established. A temporary sprinkling system or watering by truck would be required until vegetation became established.

The existing lined drainage channels on the southeast corner of the central tank farm and on the west tank farm perimeter would be covered by the side slopes of the ET cap as shown in Figure 4-5, as would a portion of Beech Street and part of the north perimeter area. New lined perimeter drains would be required on all sides of the ET cap, and lined drainage channels on the cap surface would be required at the interfaces of buildings and areas where flows converge. The existing TFIA lift station and evaporation pond would remain in service.

By 2035, the south tank farm perimeter area would be capped with an ET cover with a capillary/biobarrier. The ramp north of CPP-604 would be leveled and grading fill added over the entire south perimeter where required prior to capping. The north edge of the ET cover with a capillary/biobarrier would grade into the south edge of the ET cover with a capillary/biobarrier on the central tank farm, consistent with an overall drainage plan for the PRCZ. The asphalt applied in 2012 and any excess soil would be removed, if needed, and disposed of in an ICDF-equivalent on-Site or off-Site disposal facility prior to capping with an ET cover with a capillary/biobarrier. Alternatively, the asphalt could remain in place as a base component of the ET cover with a capillary/biobarrier.

4.4.2.3 Excavation and Capping of Tank Farm North Perimeter Area. This component of Alternative 2a includes excavating soil that exceeds the OU 3-14 future worker Cs-137 PRG of 92 pCi/g from the tank farm north perimeter area, as shown in Figure 4-2, to a maximum depth of 4 ft bgs and backfilling with clean soil, preparing a gravel subgrade for paving, and paving with low-permeability pavement. Requirements, conceptual design, and sequence of activities for excavation and capping the north tank farm perimeter are discussed below.

4.4.2.3.1 Requirements—Requirements for excavation and capping were derived from ARARs, TBC requirements, and RAOs identified previously and from BMEPs related to soil removal and capping, as follows:

1. Soil removal must meet constraints of tank farm closure schedule as discussed in Section 3.
    a. Basis: Best management practice (BMP), technical implementability.
2. Soil removal and backfilling must result in future worker excess cancer risks <1E-04.
    a. Basis: RAOs, DOE Order 435.1.
3. Soil removal implementation must limit radiological exposure of operations personnel to allowable levels.
    a. Basis: DOE Order 5400.5, PRD-183, DOE Order 440.1A, DOE Order 435.1.
4. Fugitive dust emissions must be controlled during construction.
    a. Basis: "Rules for Control of Fugitive Dust" and "General Rules," IDAPA 58.01.01.650 and 58.01.01.651.
5. Emissions of hazardous and toxic pollutants and radionuclides must be controlled during construction.
    a. Basis: Idaho air regulations, IDAPA 58.01.01.161, 58.01.01.585, and 58.01.01.586.
    b. Basis: "National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, 40 CFR 61.94(a).

6. Soil removal implementation must meet DOE and Occupational Safety and Health Administration industrial safety requirements.

   a. Basis: 29 CFR 1926, DOE Order 440.1A.

7. Excavated areas must be backfilled with clean, compacted soil to provide a stable subgrade for paving.

   a. Basis: BMEP.

8. Excavated soil must be containerized, characterized, transported, and disposed of per ICDF WAC (DOE-ID 2005b).

   a. Basis: ICDF WAC, DOE Order 435.1.

9. Low-permeability asphalt cap must reduce infiltration to less than 1 mm/yr.

   a. Basis: RAOs.

4.4.2.3.2 Conceptual Design—The conceptual design for soil removal is as described in the sequence of activities below. The conceptual design for the asphalt cover for the north tank farm perimeter is shown in Figure 4-4. Top to bottom, the configuration consists of

- 4 in. of low-permeability asphalt
- 6 in. of gravel compacted to subgrade specifications that would be developed in the RD
- 4 ft of soil contaminated at less than 92 pCi/g Cs-137, compacted to subgrade specifications that would be developed in the RD.

The low-permeability asphalt material type would be selected during RD. MatCon™ asphalt could be used in areas where standard asphalt compaction equipment could be operated, while conventional asphalt with a surface seal could be used in areas where underlying structures prohibit use of heavy equipment. The plan view of the completed asphalt cap for the tank farm north perimeter area is shown in Figure 4-5.

4.4.2.3.3 Sequence of Activities—Figures 4-5 and 4-6 show the configuration for the north tank farm perimeter area in 2012 and 2035, respectively. The sequence of activities for remediation of the north tank farm perimeter, including project preparation, characterization, excavation, disposal, backfilling, and paving, are discussed below.

4.4.2.3.3.1 Project Preparation—Project preparation would require developing site-specific project plans, surveying the site, establishing exclusion zones, installing erosion and run-off controls, installing site utilities, constructing support facilities, relocating utilities, and other activities as required. Each of these tasks is described below.

Field implementation would begin with preparation and approval of ICP work control documentation, including required project plans and a management self-assessment (MSA). The MSA would review project requirements and evaluate both ICP project and subcontractor readiness.

Required project plans would include a health and safety plan (HASP). The HASP would identify health and safety concerns regarding the remediation activities and would define the safeguards (i.e., engineering controls, administrative controls, and use of personal protective equipment [PPE]) that would be implemented to reduce risks or exposures to workers. The existing *INEEL Storm Water Pollution Prevention Plan for Construction Activities* (DOE-ID 2003) would be used to implement required sediment and run-off controls for the excavation and construction activities under Alternative 2a.

An initial site survey would be prepared to determine the baseline vertical and horizontal controls for excavation activities. The areas for the required facilities would be staked for proper location. During construction, the site survey data would provide control for excavation, backfill, and final grading. Following construction, excavation, and backfilling, a site survey would be conducted to facilitate preparation of final as-built drawings.

Prior to initiation of construction, the appropriate sediment, erosion, and run-off controls would be installed. Erosion controls could include straw bales and silt fences. Surface water controls could include construction of perimeter water control dikes and collection points. The run-off controls would be designed to control run-off from a 25-year, 6-hour precipitation event, and a contingency plan would be prepared for storms greater than the 25-year, 6-hour precipitation event.

Utility installation would include power and water supplies, fencing, and access roads. Construction fencing and physical markers would be installed to identify the boundaries of the contamination site and to limit personnel and equipment access. Existing roadways would be upgraded as necessary to accommodate construction equipment. If needed, a power line would be installed from the INTEC power source to the construction support area, equipment staging area, excavation and treatment areas, and a soil staging area. Potable water, shower, and toilet facilities would also be supplied using existing facilities, where possible.

A construction support facility would be built or an existing facility designated to support the remedial activities. ICDF facilities and equipment would be used to the extent feasible. The support facility would include an office area, a soil staging area, and a decontamination facility. The construction office would include two trailers, a lay-down area for equipment, construction parking, and temporary fencing. The decontamination facilities would include a trailer to store, remove, and dispose of PPE. There would also be decontamination facilities for construction equipment and personnel. Decontamination water and run-off from the decontamination areas would be collected in a sump and sent to the ICDF evaporation pond.

4.4.2.3.3.2 Characterization—Soil at the tank farm north perimeter area as shown on Figure 4-2 would be characterized for Cs-137 concentrations prior to excavation. Areas with concentrations less than the future worker PRG of 92 pCi/g Cs-137 at depths above 4 ft bgs would not require excavation to meet RAOs.

Characterization instrumentation would include a combination of in situ gamma-logging using the direct-reading instruments and gamma spectroscopy discussed in Section 3, as well as sampling and radiochemical analysis. The global positioning system (GPS) and conventional survey methods would be used to determine sample locations. The geographical information system (GIS) would be used to correlate spatial information with contaminant concentrations and to produce maps. Cut and fill and grading plans would be prepared using the GIS maps to direct earthwork.

4.4.2.3.3.3 Excavation—Figure 4-1 shows tank farm buildings and infrastructure projected to remain in service beyond 2012 at the north tank farm perimeter. Tanks VES-WM-103 through -106 are planned to be out of service, cleaned, and grouted by 2012. The process line connecting

Tank CPP-763 to Building CPP-604 will remain in service after 2012 to support ongoing operations, such as the PEW evaporator and service waste. Figure 4-1 does not show all of the lines that will remain in service due to uncertainties in the schedule of future facility operation and D&D. However, most of these lines are below the maximum depth of excavation and would be undisturbed by the RA. All surface infrastructure would be out of service and removed to grade by the D&D organization by 2012, with the exception of the valve boxes accessing the remaining active process lines and service waste tank VES-WM-191 that would remain in service through 2035. Out-of-service subsurface infrastructure not removed by D&D would be either removed or decontaminated as part of the RA if contaminated above allowable future worker exposure levels.

Conventional excavators could be used to remove soil at the north perimeter area because exposures are expected to be below 200 mR/hr. Conventional excavation equipment would include front-end loaders, backhoes, and excavators as shown Table 4-8. The Air Vacuum Excavation System (AVES) discussed in Section 3 is an example of equipment that could be used in proximity to utilities. Soil would be disposed of in the ICDF, and all work would be completed by 2012.

Contaminated soil would be excavated to the maximum extent shown in Figure 4-2. Estimated maximum excavation volume is approximately 3,300 yd^3; however, this volume would be reduced by characterization as much as possible. The design of any contaminated soil removal system will need to address the increased risks caused by fugitive dust emissions, worker exposures during excavation, and handling and transporting excavated soil. Confinement of the action to as small an area as possible and containment of the excavation site using temporary structures lower these risks. Wind erosion and dust generation during construction would be controlled using water sprays or dust suppressants and covering clean soil stockpiles.

Table 4-8. Examples of construction equipment for conventional excavation.

Equipment/Service Type	Example
Excavator	Case Model 9050B or CX330, Caterpillar 325L
Compactor attachment	Allied, Model 1600
Grapple attachment	Demolition, Model 65-100K
Ripper attachment	Kobelco, Model 220
Crane	60T Grove, Model RT760
Utilities	Water, electricity, potable water, lavatory facilities
Infrastructure	Access roads, road upgrades, fencing, markers, erosion and run-off control, control equipment, lighting, cameras
Construction support facility	Office area, soil staging area, decontamination facility, construction office (two trailers), lay-down area for equipment, construction parking, temporary fencing
Containment structure	Temporary tents
Waste containers	Standard ICDF roll-offs

4.4.2.3.3.4 Disposal at the ICDF—Contaminated soil and debris would be disposed of in the ICDF. The ICDF WAC (DOE-ID 2005b) contains sampling requirements for waste characterization, along with physical requirements that the waste must meet prior to disposal into the ICDF, such as stabilization of any free liquids and dimensional requirements.

The north perimeter area has no known releases and is believed to only contain low levels of contamination imported in contaminated backfill from other tank farm locations. Soil is expected to be contaminated at radioactivity levels less than 200 mR/hr and would therefore be containerized and transported to the ICDF in standard roll-off containers. The roll-off containers would be emptied and reused. Waste container transportation is expected to be managed and performed by the subcontractor operating the ICDF at the time of the remediation activities. Movement of these containers would require transporting them over the west perimeter road, which is a public-access road, and Department of Transportation regulations would be followed during this transport activity.

4.4.2.3.3.5 Backfilling—Backfilling of excavated areas is similar to ET soil cover construction, discussed previously.

4.4.2.4 Low-Permeability Asphalt. Low-permeability asphalt would be applied over the south tank farm perimeter area, the PRCZ outside the tank farm, CPP-58, and CPP-15 if infrastructure was removed, as shown in Figure 4-2. Paving would be completed prior to construction of the ET cap with a capillary/biobarrier since the cap will overlay portions of the paved areas as shown in Figure 4-5. Requirements that must be met by the low-permeability asphalt, a conceptual design to meet the requirements, and a sequence of activities required for implementation are presented below.

4.4.2.4.1 Requirements—Requirements for the low-permeability asphalt were derived from ARARs, TBCs, and RAOs identified previously and BMEPs related to capping as follows:

1. Paving design and implementation must meet the constraints of the tank farm closure schedule as discussed in Section 1.3.6.

    a. Basis: BMEP.

2. Paving on the ramp north of CPP-604 must be trafficable for vehicles that use the ramp.

    a. Basis: BMEP.

3. The low-permeability asphalt must reduce infiltration rates to approximately 1 mm/yr based on modeling results reported in Appendix A.

    a. Basis: RAOs.

4. The low-permeability asphalt must be sloped to promote drainage and minimize erosion of the cover.

    a. Basis: RAOs, BMEP.

5. Radiological exposures during construction must be controlled to levels as low as reasonably achievable.

    a. Basis: PRD-183, DOE Order 440.1A, DOE Order 435.1.

6. Fugitive dust emissions must be controlled during construction.

    a. Basis: "Rules for Control of Fugitive Dust" and "General Rules," IDAPA 58.01.01.650 and 58.01.01.651.

7. Emissions of hazardous and toxic pollutants and radionuclides must be controlled during construction.

   a. Basis: Idaho air regulations, IDAPA 58.01.01.161, 58.01.01.585, and 58.01.01.586.

   b. Basis: "National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, 40 CFR 61.94(a).

4.4.2.4.2 Conceptual Design—Figure 4-3 shows a cross-sectional view of the low-permeability asphalt cap. The subgrade shown would be compacted to specifications defined during remedial design. A 6-in.-thick layer of gravel would be placed over subgrades lacking gravel and compacted. A 4-in.-thick layer of low permeability asphalt would be placed over the gravel in a single lift and compacted using standard asphalt paving equipment. A surface sealer would be applied if needed to attain the required permeability.

4.4.2.4.3 Sequence of Activities—Project preparation would include identifying and prequalifying asphalt mix aggregate sources and identifying and prequalifying a contractor to manufacture and place the hot mix. Guide specifications and a quality assurance plan would be prepared by the contractor for the manufacture and installation.

Existing surface grades are assumed to be > 1% and adequate for drainage. Some areas near buildings would require excavating existing soil or pavement to a depth equal to the asphalt cap thickness prior to capping to allow for building access. Areas shown in Figure 4-2 to be covered by low-permeability asphalt would be surveyed. Vegetation, debris, or other materials that could interfere with compaction of the subgrade would be removed. Subgrades in the area would be compacted using standard roller compactors.

A 6-in.-thick layer of gravel would be placed over subgrades lacking gravel in a single lift and compacted to specifications. A test pad would be constructed, cured, and cored, and the cores would be tested for saturated hydraulic conductivity to verify that the low-permeability cap can be constructed to the required permeability.

A 4-in.-thick layer of low-permeability asphalt would be placed over the gravel in a single lift and compacted using standard asphalt paving equipment. Interfaces between the asphalt and other materials or structures would be sealed using an appropriate bonding material. Surface sealer would be applied if conventional asphalt was used.

4.4.2.5 Operations and Maintenance. O&M for institutional controls for Alternative 2a would be as described for Alternative 1. O&M of the ET cover with a capillary/biobarrier, low-permeability pavement cover and TFIA storm water controls are described below.

4.4.2.5.1 ET Cover with a Capillary/Biobarrier—O&M of the ET cover with a capillary/biobarrier would include annual cover inspection and repair of specific deficiencies listed below:

- <u>Erosional damage</u>. Rills deeper than about 4 in. would be filled and compacted using topsoil and equipment appropriate to the scale of the erosional features and as per design specifications. Excessive compaction would not be used.

- <u>Animal burrows</u>. All animal burrows deeper than about 4 in. would be filled and compacted using topsoil and equipment appropriate to the scale of the erosional features and as per design specifications. Excessive compaction would not be used.

- Subsidences. All subsidences greater than about 1 ft in depth relative to the surrounding grade would be filled and compacted using topsoil and equipment appropriate to the scale of the erosional features and per design specifications. Excessive compaction would not be used.

- Condition of vegetation. The condition of surficial vegetation would be noted. Areas greater than about 10,000 ft^2 lacking vegetation would be reseeded, fertilized, and/or watered as needed to reestablish vegetation, as per RD specifications.

4.4.2.5.2 Low-Permeability Pavement—O&M for low-permeability asphalt would consist of semiannual visual inspections for distressed pavement, cracking, ponding, or damage. Paving distress includes

- Excessive weathering or disintegration
- Thermal cracking
- Fatigue cracking
- Abrasions
- Scuffing
- Surface wear caused by equipment use
- Settlement, subsidence, and/or ponding of water
- Deformation or rutting caused by traffic or storage loading.

Any accumulated sediment or vegetation would be removed. Areas of contact between pavement and structures would be inspected for separation or cracking. Surface deterioration, e.g., weathering, abrasion, scuffing, raveling, or surface wear could be repaired using a restorative fog seal. Settlement, subsidence, ponding of water, deformation, or rutting could be corrected by overlaying additional asphalt to change the surface grade. Cracks deeper than about 1 in. would be routed out rather than sawed or cut, air-blasted to remove debris, and filled using hot applied sealant. Large cracks or subsidences could be repaired by sawing and removing the failed material and rebuilding the area as per the pavement construction specifications.

4.4.2.5.3 TFIA Storm Water Control System—Inspection, operation, and maintenance of the existing TFIA storm water control system are described in DOE-ID (2005a).

4.4.2.6 Monitoring. Monitoring for institutional controls for Alternative 2a would be as described for Alternative 1. Monitoring for soil covers includes annual inspections and is addressed under O&M. Monitoring for the SRPA is assumed to be addressed under the existing OU 3-13 Group 5 remedy, which would become part of the OU 3-14 remedial response via the OU 3-14 ROD. The monitoring under Group 5 is adequate for OU 3-14 monitoring and includes a more extensive list of radionuclides every 2 years until 2015 and then every 5 years beginning in 2015 (DOE-ID 2004). No additional wells are assumed to be required.

4.4.3 Alternative 2b—Institutional Controls, Monitoring, Excavation, and Containment by 2035

Alternative 2b provides for the contingency that continuing INTEC operations, or delays in completing tank grouting or D&D of surface structure, may prevent implementation of a final remedy until 2035, the assumed date when INTEC operations will end. Table 4-7 shows the components of Alternative 2b. Alternative 2b differs from Alternative 2a in that the central tank farm area would receive a low-permeability asphalt cap by 2012 for recharge control, pending a final ET capillary/biobarrier cap implemented by 2035, thereby eliminating the need to demolish Buildings CPP-654 and CPP-699 and to construct a retaining wall to protect Building CPP-659. All of these structures would be demolished to grade and the surface prepared for final capping by the D&D program prior to constructing the ET cap with a capillary/biobarrier by 2035. Note that Table 4-7 shows that constructing an ET capillary/biobarrier cap over the north perimeter tank farm area and the PRCZ outside the tank farm could be evaluated during Phase II remedial design as an alternative to maintaining the low-permeability asphalt cap in these areas until at least 2129.

Figure 4-9 shows the 2012 configuration for Alternative 2b. The 2035 configuration would be the same as for Alternative 2a, as shown in Figure 4-6. Requirements, conceptual design, and sequence of activities for paving the central tank farm would be as described previously in Section 4.4.2.4 for perimeter areas.

4.4.4 Alternative 3a—Source Removal and Containment by 2012

Alternative 3a would remove residual Sr-90 contained in soil at Site CPP-31 in an effort to meet SRPA RAO I. As shown in Table 4-7, Alternative 3a is identical to Alternative 2a, except that CPP-31 soil would be excavated and disposed of at ICDF prior to constructing an ET cap with a capillary/biobarrier over the central tank farm. The 2012 and 2035 configurations for Alternative 3a would be the same as shown in Figures 4-5 and 4-6, respectively, for Alternative 2a. The requirements, conceptual design, and sequence of activities for removal and disposal of CPP-31 soil are described below.

4.4.4.1 Requirements. Requirements for soil removal were derived from ARARs, TBC requirements, and RAOs identified previously and from BMEPs related to soil removal, as follows:

1. Soil excavation must remove sufficient Sr-90 from Site CPP-31 such that mass flux from soil does not result in or contribute to concentrations in the SRPA that exceed maximum contaminant levels (MCLs) after 2095.
    a. Basis: RAOs; “Idaho Ground Water Quality Rule,” IDAPA 58.01.11; DOE Order 435.1.
2. Soil removal must meet constraints of tank farm closure schedule as discussed in Section 3.
    a. Basis: BMP, technical implementability.
3. Soil removal and backfilling must result in future worker excess cancer risks <1E-04.
    a. Basis: RAOs, DOE Order 435.1.
4. Soil removal implementation must limit radiological exposure of operations personnel to allowable levels.
    a. Basis: DOE Order 5400.5, PRD-183, DOE Order 440.1A, DOE Order 435.1.

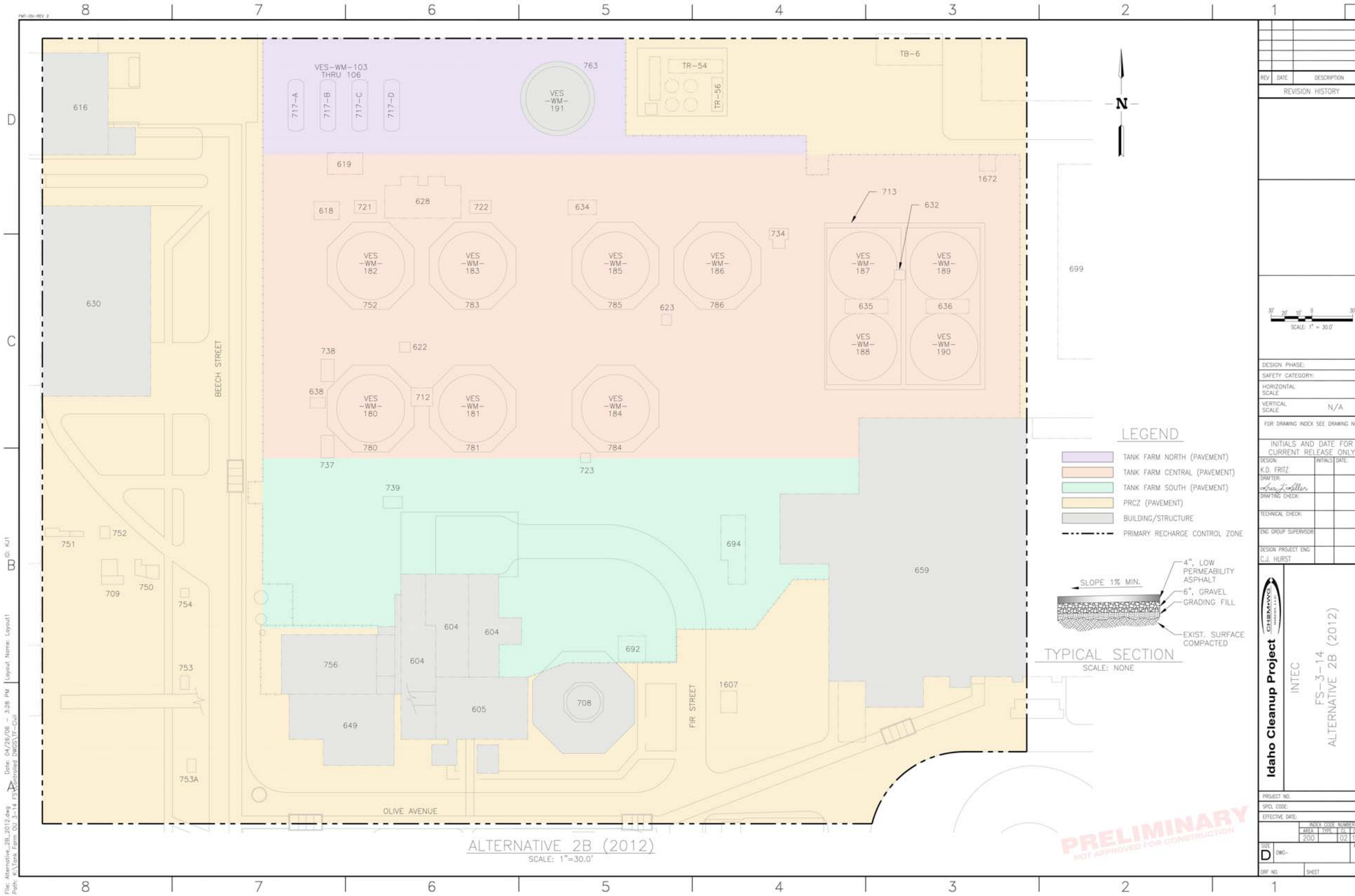


Figure 4-9. Alternative 2b configuration in 2012.

5. Fugitive dust emissions must be controlled during construction.

   a. Basis: “Rules for Control of Fugitive Dust” and “General Rules,” IDAPA 58.01.01.650 and 58.01.01.651.

6. Emissions of hazardous and toxic pollutants and radionuclides must be controlled during construction.

   a. Basis: Idaho air regulations, IDAPA 58.01.01.161, 58.01.01.585, and 58.01.01.586.

   b. Basis: “National Emission Standards for Hazardous Air Pollutants,” 40 CFR 61.93, 40 CFR 61.94(a).

7. Soil removal implementation must meet DOE and Occupational Safety and Health Administration industrial safety requirements.

   a. Basis: 29 CFR 1926, DOE Order 440.1A.

8. Excavated areas must be backfilled with clean, compacted soil to provide a stable subgrade for tank farm operations projected through 2035.

   a. Basis: BMEP.

9. Excavated soil must be containerized, characterized, transported, and disposed of per ICDF WAC (DOE-ID 2005b).

   a. Basis: ICDF WAC, Order DOE 435.1.

10. Backfilled areas must meet the surface completion requirements as for the ET soil cover.

    a. Basis: RAOs.

4.4.4.2 Conceptual Design and Sequence of Activities. CPP-31 soil removal would consist of project preparation, excavating contaminated soil, characterizing the excavated soil for disposal, decontaminating equipment, and restoring the excavated site. Conceptual designs for each of these removal phases is described below.

4.4.4.2.1 Project Preparation—Project preparation would require developing site-specific project plans, surveying the site, establishing exclusion zones, installing erosion and run-off controls, installing site utilities, constructing support facilities, relocating utilities, and other activities as required. Each of these tasks is described below.

Field implementation would begin with preparation and approval of ICP work control documentation, including required project plans and a MSA. The MSA would review project requirements and evaluate both ICP project and subcontractor readiness.

Required project plans would include a HASP. The HASP would identify health and safety concerns regarding the remediation activities and would define the safeguards (i.e., engineering controls, monitoring, PPE) that would be implemented to reduce risks or exposures to workers. The existing *INEEL Storm Water Pollution Prevention Plan for Construction Activities* (DOE-ID 2003) would be used to implement required sediment and run-off controls for the excavation and construction activities under Alternatives 2a and 2b.

An initial site survey would be prepared to determine the baseline vertical and horizontal controls for excavation activities. The areas for the required facilities would be staked for proper location. During construction, the site survey data would provide control for excavation, backfill, and final grading. Following construction, excavation, and backfilling, a site survey would be conducted to facilitate preparation of final as-built drawings.

Prior to initiation of construction, the appropriate sediment, erosion, and run-off controls would be installed. Erosion controls could include straw bales and silt fences. Surface water controls could include construction of perimeter water control dikes and collection points. The run-off controls would be designed to control run-off from a 25-year, 6-hour precipitation event, and a contingency plan would be prepared for storms greater than the 25-year, 6-hour precipitation event.

Wind erosion and dust generation during construction in preparation for excavation would be controlled using water sprays or dust suppressants and covering clean soil stockpiles. As needed, dust suppression during excavation would be controlled using a negative-pressure containment building over the soil contamination site.

Utility installation would include power and water supplies, fencing, and access roads. Construction fencing and physical markers would be installed to identify the boundaries of the contamination site and to limit personnel and equipment access. Existing roadways would be upgraded as necessary to accommodate construction equipment. If needed, a power line would be installed from the INTEC power source to the construction support area, equipment staging area, excavation and treatment areas, and a soil staging area. Potable water, shower, and toilet facilities would also be supplied using existing facilities, where possible.

A construction support facility would be built or an existing facility designated to support the remedial activities. ICDF facilities and equipment would be used to the extent feasible. The support facility would include an office area, a soil staging area, and a decontamination facility. The construction office would include two trailers, a lay-down area for equipment, construction parking, and temporary fencing. The decontamination facilities would include a trailer to store, remove, and dispose of PPE. There would also be decontamination facilities for construction equipment and personnel. Decontamination water and run-off from the decontamination areas would be collected in a sump and sent to the ICDF evaporation pond.

Due to the presence of soil with direct radiation exposure levels of over 20 R/hr, most of the CPP-31 contaminated soil would be remotely excavated, containerized, and characterized in a negative-pressure enclosure constructed over Site CPP-31. A sprung structure with shielding and a foundation would be built depending on requirements for the structure identified in the RD. The footprint of the structure would be 250 × 175 ft, which includes a 50-ft buffer on all sides of the excavation for equipment staging and access.

A negative-pressure working environment with airlocks would be maintained to minimize contaminated fugitive dust emissions and to reduce exposures to workers. All ventilated air would be filtered through a high-efficiency particulate air (HEPA) filter before being discharged outside the enclosure. Air discharges would be continuously monitored for radionuclide releases during excavation and treatment. Other radiological control monitoring would be identified during RD. A fire detection and alarm system and continuous video monitoring would be included.

4.4.4.2.2 Excavation—Site CPP-31 is shown in Figure 4-1. The total volume of the soil to be excavated is approximately 17,625 yd^3. This total volume includes the volumes of soil beneath the site's perimeter down to basalt less the volumes of the tank vaults.

Several assumptions specific to excavation and disposal of CPP-31 soil include the following:

- No criticality concerns will be identified for retrieved soil.
- No structures will remain above grade in CPP-31 after the start of FY 2011.
- Tanks, piping, and valve boxes will be cleaned and grouted except the transfer line from CPP-604 to the New Waste Calcining Facility.
- Soil to 25 ft bgs will have radiation readings of up to 20 R/hr and will be too radioactive to be contact-handled and will therefore be remote-handled.
- Soil from 25 ft to basalt would be contact-handled.
- Compliance with Department of Transportation regulations for the haul road from the tank farm to the ICDF would not add cost or complexity to the project.
- No Safety Analysis Report or auditable safety analysis will be required.

Based on downhole gamma profiles and soil sampling analytical results reported in the OU 3-14 RI/BRA, soil from 0 to 25 ft bgs would be remote-excavated using a combination of remote methods. These could include a remotely operated excavator that can be configured with a variety of tooling such as excavator buckets of various sizes, cutting jaws, saws, and percussion hammers; and also vacuum excavation. Two remotely operated Caterpillar 325L excavators equipped as described in Section 3 could potentially be used, one with a bucket for excavation and a second with pulverizer jaws or shears for debris size reduction.

Soil from the 0 to 25-ft-bgs interval would be loaded directly into B-90 boxes (metal waste-boxes used by Waste Generator Services) for transport to the ICDF. Materials, such as piping and concrete, would be reduced in size within the excavation using a second remote excavator or other size-reduction equipment and also loaded into B-90s. The B-90 boxes would be placed into a reusable shielded container. No staging of soil would occur. A net removal rate of 2 yd^3/hr was estimated for the 0 to 25-ft-bgs interval, based on previous experience with remote operations and other conventional retrievals.

Soil from 25 ft bgs to basalt (40-ft depth except by Tank WM-181, which is 60-ft depth) would be removed by conventional excavation, using sealed and shielded operator cabins, because exposures are expected to be below 200 mR/hr based upon downhole gamma profiles and soil sampling analytical results reported in the OU 3-14 BRA. Conventional excavation equipment would include front-end loaders, backhoes, and excavators as shown Table 4-8. Excavators would be modified, as needed, with grapple and ripper attachments to remove buried, decommissioned process lines and other structures and to reduce the size of retrieved materials prior to disposal. The AVES discussed in Section 3 is an example of equipment that could be used in proximity to utilities. Soil would be disposed of in the ICDF, and all work would be completed by 2012.

Contaminated soil would be excavated to the extent shown in Figure 4-1. Estimated excavation volume is approximately 16,419 yd^3, including removal of overburden. Shoring would be used to stabilize the excavation as needed.

The design of any contaminated soil removal system will need to address the increased risks caused by fugitive dust emissions, worker exposures during excavation, and handling and transporting excavated soil. Confinement of the action to as small an area as possible and containment of the excavation site using temporary structures lower these risks.

Conventional excavators using a 1-yd^3 bucket and a 60-yd^3/day production rate were assumed based on previous experience with conventional retrievals on the INL Site. Cross-braced shoring would be used to support the excavation, and a ramp from the west end of CPP-31 would be used for excavator access. Soil excavated would be loaded on a conveyor for removal from the hole directly into 15-yd^3 rolloff containers for transport to the ICDF. Staging of soil, except in the excavation, would be avoided where possible.

Based on the projected excavation rates, and allowing for 25% downtime, the estimated 17,625 yd^3 of contaminated tank farm (CPP-31) soil could be excavated and disposed of in ICDF in about 2 years using two 10-hr shifts per day, 6 days per week.

4.4.4.2.3 Characterization—Containerized soil removed from the excavation would be sampled and analyzed for ICDF WAC constituents, including sufficient analyses for Sr-90 to estimate the mass removed from the excavation to determine effectiveness of the remedy. Final acceptance testing of the extent of cleanup would likely include core sampling of soil remaining in place and analysis for Sr-90.

4.4.4.2.4 Disposal at the ICDF—Excavated soil and debris would be disposed of at the ICDF. The ICDF WAC (DOE-ID 2005b) contains sampling requirements for waste characterization, along with physical requirements that the waste must meet prior to disposal into the ICDF, such as stabilization of any free liquids and dimensional requirements.

Soil contaminated at radioactivity levels less than 200 mR/hr would be containerized and transported to the ICDF in standard roll-off containers. These roll-off containers would be emptied and reused.

Excavated soil with activities greater than 200 mR/hr would be placed in appropriately shielded containers, such as B-90s, for handling, storage, and transport. These containers could be placed in secondary containers for additional shielding, as necessary, to achieve the shielding requirements specified by DOE. Where necessary to reduce dose to workers, the filled containers would be directly deposited into the ICDF (not reused).

Waste container transportation is expected to be managed and performed by the subcontractor operating the ICDF at the time of the remediation activities. Movement of these containers would require transporting them over the west perimeter road, which is a public-access road, and Department of Transportation regulations would be followed during this transport activity.

4.4.4.2.5 Decontamination—All equipment, containers, and personnel would exit the secondary containment enclosure through an airlock into a decontamination facility. One or more decontamination facilities for personnel and equipment may be constructed at the egress points of the tank farm enclosure; however, for cost-estimating purposes, one centralized decontamination facility was assumed. The decontamination facility would accommodate personnel, equipment, and soil containers. Decontamination methods for equipment and containers would include waste minimization technologies, such as carbon dioxide pellet blasting, as well as conventional methods, such as water and steam spray wands. Secondary waste streams would be minimized to the extent possible. Decontamination water would be collected and disposed of at the ICDF evaporation pond. Equipment and materials, such as

HEPA filters, that cannot be decontaminated sufficiently for clean release would be dismantled and disposed of at the ICDF.

4.4.4.3 Monitoring. Monitoring requirements for Alternative 3a are as described for Alternative 2a.

4.4.4.4 Operations and Maintenance. O&M requirements for Alternative 3a are as described for Alternative 2a.

4.4.5 Alternative 3b—Source Removal and Containment by 2035

Alternative 3b provides for the contingency that continuing INTEC operations or delays in completing tank grouting or D&D of surface structure may prevent implementation of a final remedy until 2035, the assumed date when INTEC operations will end. Table 4-7 shows the components of Alternative 3b. Alternative 3b differs from Alternative 3a in that the central tank farm area would receive a low-permeability asphalt cap for recharge control by 2012, pending CPP-31 soil removal and disposal, and a final ET cover with a capillary/biobarrier, implemented by 2035. This approach would eliminate the need to demolish Buildings CPP-654 and CPP-699 by 2012, and to construct a retaining wall to protect Building CPP-659. All of these structures would be demolished to grade and/or prepared for final capping by the D&D program prior to constructing the ET cap with a capillary/biobarrier by 2035. Additionally, the ICDF is projected to close in 2013 and would not be available for disposal of CPP-31 soil for this alternative.

The 2012 configuration for Alternative 3b would be the same as shown in Figure 4-9 for Alternative 2b. The 2035 configuration would be the same as for Alternative 2a, as shown in Figure 4-6.

4.4.6 Alternative 4a—Source Treatment and Containment by 2012

Alternative 4a would immobilize residual Sr-90 contained in soil at Site CPP-31 in situ, in an effort to meet SRPA RAO I. As shown in Table 4-7, Alternative 4a is identical to Alternative 2a, except that CPP-31 soil would be treated in situ prior to constructing an ET cap with a capillary/biobarrier over the central tank farm. The 2012 and 2035 configurations for Alternative 4a would be the same as shown in Figures 4-5 and 4-6, respectively, for Alternative 2a.

The requirements, conceptual design, and sequence of activities for in situ treatment of CPP-31 soil are described below.

4.4.6.1 Requirements. Requirements for in situ soil treatment derived from ARARs, TBCs, and RAOs identified previously; and BMEPs related to in situ soil treatment are listed below.

1. In situ treatment must meet the constraints of the tank farm closure schedule as discussed in Section 3.

   a. Basis: BMEP, technical implementability.

2. Treated areas must provide a stable subgrade for the ET cover with a capillary/biobarrier.

   a. Basis: BMEP, technical implementability.

3. In situ treatment must sufficiently immobilize Sr-90 at Site CPP-31 such that mass flux from soil does not result in or contribute to concentrations in the SRPA that exceed MCLs.

   a. Basis: RAOs.

4. In situ treatment must immobilize Sr-90 for at least 300 years.

   a. Basis: Conservative estimate based on RAOs. 300 years = roughly 10 half-lives for Sr-90, assumed to be adequate to reduce soil concentrations to allowable levels.

5. Radiological exposure of operations personnel during remedy implementation must be controlled to ALARA levels.

   a. Basis: PRD-183, DOE Order 440.1A, DOE Order 435.1.

6. Emissions of fugitive dust must be controlled during construction.

   a. Basis: "Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and 58.01.01.651.

7. Emissions of hazardous and toxic pollutants and radionuclides must be controlled during construction.

   a. Basis: Idaho Air Regulations, IDAPA 58.01.01.161, 58.01.01.585, and 58.01.01.586.

   b. Basis: "National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, 40 CFR 61.94(a).

4.4.6.2 Conceptual Design. Conceptual design for in situ treatment of CPP-31 soil is based on the requirements identified previously, vendor information, and field demonstrations at the INL Site and other DOE sites performed over the past 10 years. The actual layout plan, grout formulation, and injection equipment would be refined during RD and cold testing at INTEC. Any product names mentioned below are for pricing purposes only and would not necessarily be used.

4.4.6.2.1 Layout Plan—Figure 4-10 shows a conceptual layout plan for borehole installation at CPP-31. The approach would use vertical boreholes to contact the contaminated soil with grout. The entire interval from near ground surface to basalt, which occurs at about 45 to 60 ft bgs in the area shown, would be grouted. The layout is oriented along the length of the CPP-601/-602 concrete pipe encasement, which was identified in the OU 3-14 RI/BRA report as an apparent preferential flowpath for the liquid release. The length of the contaminated soil zone surrounding the encasement is about 160 ft. Assuming a 2.5-ft radius of influence, boreholes would be spaced at 4-ft intervals on center to allow for overlapping of treated soilcrete columns. The width of the pile cap that supports the concrete encasement, shown in the OU 3-14 RI/BRA report, Figure 3-16, is about 4.5 ft. Boreholes would be drilled as close as possible to the pile cap, based on existing drawings and an initial ground-penetrating radar or other survey that would be used to locate subsurface structures.

The boreholes that could not be completed due to surface or subsurface infrastructure using this spacing, based on existing drawings, are shown on Figure 4-10 in black and red, respectively. Boreholes that could be completed without encountering infrastructure are shown in blue. The overall borehole completion success using this approach is discussed in Section 5.

Single-fluid jet grouting can produce "soilcrete" column diameters of 2 to 3.5 ft in sands and gravels. Use of an air jet during grouting can increase the column diameter to 3 to 10 ft in sands and gravels. A cold test would be required to determine actual achievable grouted column diameters in INTEC alluvium; however, 5 ft is to be believed achievable based on product literature.

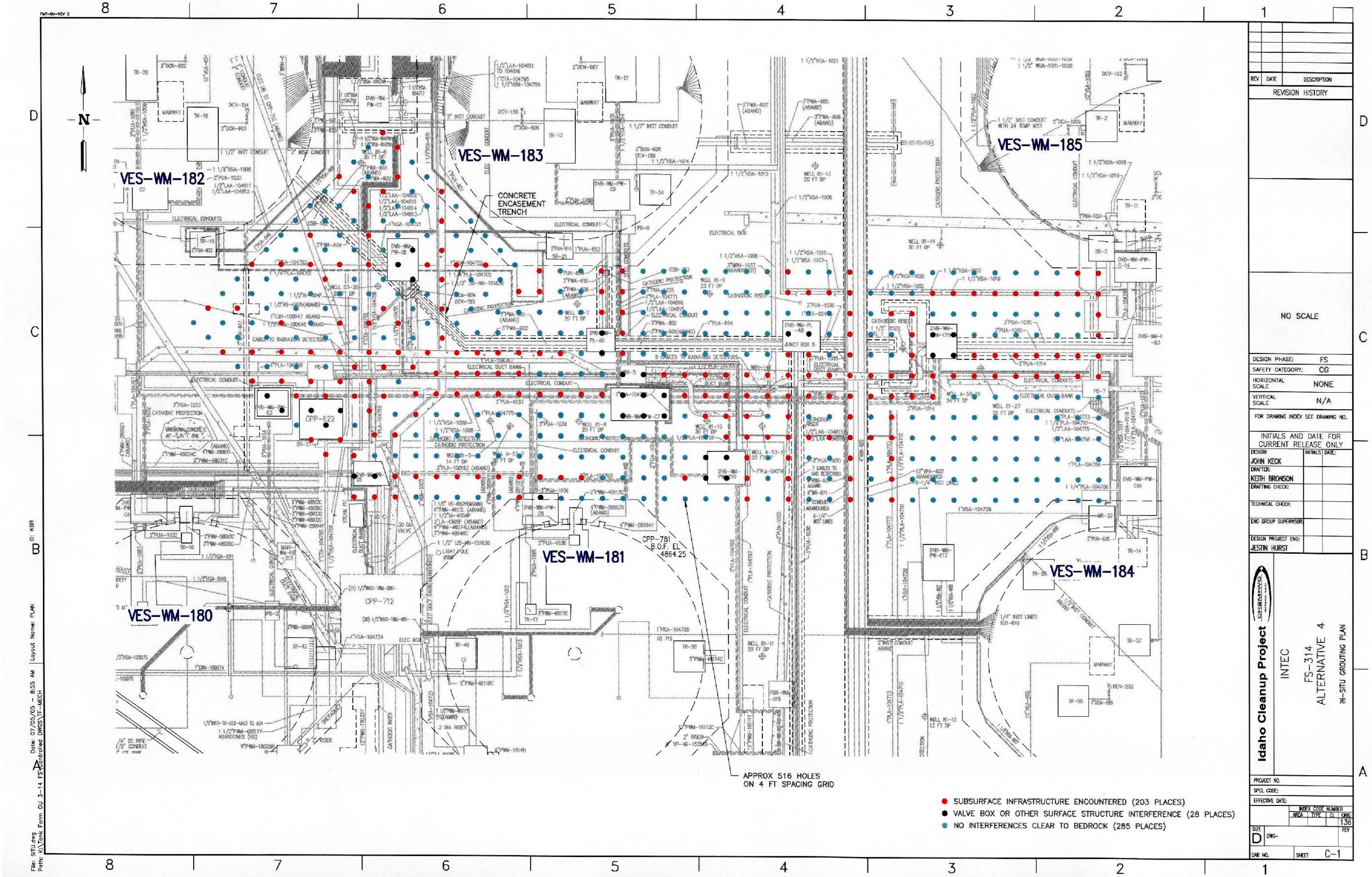


Figure 4-10. Conceptual layout plan for in situ grouting.

4.4.6.2.2 Materials and Equipment—Table 4-9 summarizes major equipment required to implement the conceptual design. All equipment and materials discussed were identified in previous INL Site bench-and field-testing and would be reevaluated during RD and cold testing (INEEL 2003). The selected grout for conceptual design and pricing purposes is a pozzolonic cement manufactured by U.S. Grout, Malad, Idaho, using Type-H cement and local Idaho pumice (INEEL 2003). INL Site soils grouted using this cement were determined at bench-scale to have high compressive strength, high resistance to nitrate salts, and high retention of strontium. The grout has a sufficiently long cure time to allow for injection and was demonstrated at field-scale for grouting Subsurface Disposal Area (SDA) wastes and INL Site soils (INEEL 2003). Alternative grouts may be selected during RD and cold testing.

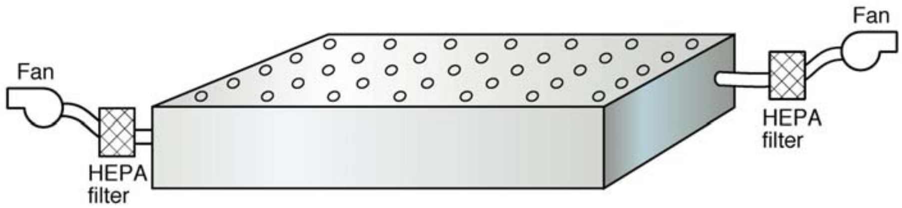
Representative in situ grouting technology capable of meeting requirements includes a Casa Grande C-6 track-mounted rotopercussion drilling/grouting rig, using a 9-cm-diameter drill stem, a high-pressure pump, a low-pressure feed pump, and high-pressure hoses. This equipment was used successfully at the INL Site in situ grouting field demonstrations (INEEL 2003). Each borehole would be drilled to basalt, and grout would be injected at 6,000 psi through the rotating drill stem while withdrawing it.

A thrust block assembly designed for the INL Site in situ grouting demonstrations (INEEL 2003) and full-scale implementation at the SDA (ICP 2005) would be used to control dust emissions and surface exposures. This apparatus consists of a steel box with holes at the prescribed distances to allow for insertion of the drill string. Each hole has a diaphragm seal and a double plastic bag, plus a metal recessed lid. Following grouting, the drill string is withdrawn and cleaned by the wiper assembly and the plastic sack is twisted, taped, and cut. The thrust block also provides volume for collecting grout returns, as well as a clean area for worker protection from surface exposures and a degree of radiation shielding.

Assuming that 10 boreholes could be completed per day, the actual grouting could be completed in 52 working days or about 3 months. Assuming 15 gal grout per foot of borehole, based on representative values reported in INEEL (2003) for Portland cement-type grouts, about 750 gal of grout would be required for each column. Actual grout "take" could be higher based on the likelihood of voids under the concrete encasement and other infrastructure. Total grout required, assuming 5% returns and based on INEEL (2003), is estimated at about (100 ft^3/column × 516 columns)(1.05) = 5.4E+04 ft^3.

Table 4-9. Example materials and equipment required for in situ grouting.

Equipment Type	Example Specification or Model
Portland cement	Pozzolonic cement manufactured by U.S. Grout, Malad, Idaho, using Type-H cement and local Idaho pumice (INEEL 2003) or equivalent as determined in laboratory testing (2.5E+06 lb total)
Water	20-gpm supply minimum
Jet grouting rig	Casa Grande C-6 track-mounted rotopercussion drilling/grouting rig or equivalent
Thrust block assembly	Fabricated per INEEL (2003) specifications and as shown in Figure 4-11
Mixing plant	30-gpm minimum (Casa Grande Mix 20 automatic grout mixing system or equivalent)
High-pressure grout pump	6,000-psi minimum
Low-pressure grout feed pump	30-gpm minimum



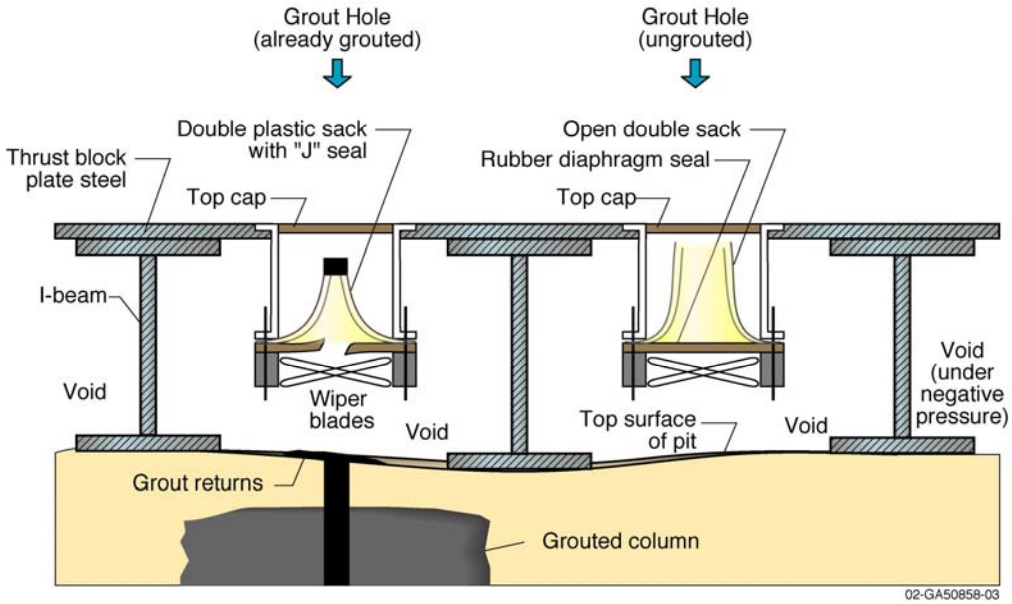


Figure 4-11. Thrust block assembly (INEEL 2003).

Assuming a 1:1 (w/w) mix of cement:water, this results in a requirement of about 2.7E+04 ft^3 total of dry Portland cement. Using a cement dry density of about 94 lb/ft^3 results in a requirement for about 2.5E+06 lb total of dry Portland cement.

Assuming a drill string withdrawal rate of about 2 ft/min reported in INEEL (2003), a grout plant capable of supplying at least 30 gpm would be required. A Casa Grande Mix 20 automatic grout mixing system (shown below) meets this requirement. A water supply of at least 20 gpm would be needed assuming a 1:1 (w/w) cement:water mix. Based on vendor information, the resulting soilcrete columns would have a compressive strength of 500 to 3,000 psi.

Note that these conceptual calculations are based in part on INEEL (2003) laboratory and field study results, as well as on vendor information. Soil conditions at the SDA (silt loess) are much different than at INTEC (sandy gravel alluvium) and actual grout formulations and requirements would likely vary, especially if an air jet is used for jet grouting. Any in situ grouting approach considered for CPP-31 would require laboratory and field-scale testing during RD.

Note also that the INTEC tank farm closure project will also use grout for final closure of the tanks. Much of the required equipment, including the grout mixing plant and transfer pumps used for the tank closure project, may be applicable for in situ grouting.

4.4.6.3 Sequence of Activities—A conceptual sequence of activities is described below. Much of this information was adapted from the *Summary Report for the OU 7-13/14 Early Actions Beryllium Encapsulation Project* (ICP 2005). This information is provided only to support the conceptual design for this FS and would be defined during RD and preparation of the RA work plan.

This technology would be implemented under Alternative 3a before 2012, when tank farm infrastructure in the CPP-31 area is projected to no longer be in service. The waste tanks are projected to be grouted by 2012, and the tank farm surface loading restrictions will have been removed. All surface structures are scheduled to be removed by D&D by 2012, allowing for operating the tracked drilling rig and installing boreholes. Subsurface infrastructure, including shallow piping located above the contaminated soil zone, might additionally be removed to allow for drilling.

Cold testing would be required to determine the contact radius of jet grouting equipment at INTEC and to determine operational readiness. Cold testing would likely require initial laboratory testing of cement types and cement:water ratios to determine a preferred formulation. Subsequent field testing would likely include drilling and grouting at least four holes to at least 50 ft bgs in an uncontaminated location with the same disturbed alluvial soil as is found in the tank farm, allowing the grout to cure, and then excavating the grouted soilcrete columns for examination of extent of contact of the grout with the soil. This would likely be performed at borehole spacings ranging from 2 to 5 ft. The results of cold testing would be used to evaluate operational readiness of the selected equipment and subcontractors.

Field implementation would begin with preparation and approval of ICP work control documentation, including required project plans and an MSA. The MSA would review project requirements and evaluate both ICP project and subcontractor readiness.

Required project plans would include a HASP. It would identify health and safety concerns regarding the remediation activities and would define the safeguards (i.e., engineering controls, monitoring, PPE) that would be implemented to reduce risks or exposures to workers. The existing *INEEL Storm Water Pollution Prevention Plan for Construction Activities* (DOE-ID 2003) would be used to implement required sediment and run-off controls for the excavation and construction activities under this alternative.

The site would be surveyed to identify and flag borehole locations. Equipment would be mobilized to the site, including the drill rig, thrust block, grout plant, grout pumps, and dry cement storage. Utilities, including water and electricity, would be connected.

Grouting would begin using the jet grouting rig. A 4-ft borehole spacing would require about 516 boreholes total. Boreholes would be completed to basalt at 45 to 60 ft bgs or refusal. If refusal was encountered above the expected completion depth, the hole would be grouted, the location marked, and the drill rig moved to the next hole in the thrust block. Assuming that 10 boreholes could be completed per day, the actual grouting could be completed in 52 working days or about 3 months.

During grouting operations, a HEPA-filtered ventilation system would sweep gas from the thrust block and exhaust the gas to the atmosphere in an unoccupied area. The HEPA filter would trap any particulate contamination entrained in the sweep flow.

Angle-drilling or different vertical borehole locations could be used to improve the effectiveness of completion. One hundred percent effectiveness of completion of holes would not be possible, based on the extent of subsurface infrastructure; effectiveness of the treatment is discussed further in Section 5. About 1.5E+04 yd^3 of soil would have to be grouted, based on the layout plan shown in Figure 4-10, projected to bedrock.

Grout returns would be collected in the thrust block and removed using an excavator when the thrust block was moved between locations. Grout returns and contaminated incidental wastes, including HEPA filters and PPE, would be transferred to boxes and trucked to the ICDF for disposal.

All equipment would be decontaminated as described for Alternative 3a. Any equipment that could not be decontaminated would be disposed of in the ICDF. Total duration of activities would likely be on the order of 12 to 18 months, including document preparation, cold testing, procurement of equipment, field implementation, and decontamination. Following completion of grouting, the site would be covered with an ET cover with a capillary/biobarrier.

4.4.6.4 Monitoring. Monitoring requirements and conceptual design for Alternative 4a are as described for Alternative 2a, except that cores of the treated soil would be collected to determine the effectiveness of the treatment. No additional monitoring requirements are established for the treated soil.

4.4.6.5 Operation and Maintenance. O&M requirements for Alternatives 4a and 4b are as described for Alternatives 2a and 2b, respectively. No additional monitoring requirements are established for Alternatives 4a and 4b.

4.4.7 Alternative 4b—Source Treatment and Containment by 2035

Alternative 4b provides for the contingency that continuing INTEC operations or delays in completing tank grouting or D&D of surface infrastructure may prevent implementation of a final remedy until 2035, the assumed date when INTEC operations will end. Table 4-7 shows the components of Alternative 4b. Alternative 4b differs from Alternative 4a in that the central tank farm area would receive a low-permeability asphalt cap for recharge control by 2012, pending CPP-31 in situ treatment, and a final ET cover with a capillary/biobarrier, implemented by 2035. This approach would eliminate the need to demolish Buildings CPP-654 and CPP-699 by 2012 and to construct a retaining wall to protect Building CPP-659. All of these structures would be demolished to grade and/or prepared for final capping by the D&D program prior to constructing the ET cap with a capillary/biobarrier by 2035. Additionally, the ICDF is projected to close in 2013 and would not be available for disposal of grout returns and other secondary wastes for this alternative.

The 2012 configuration for Alternative 4b would be the same as shown in Figure 4-9 for Alternative 2b. The 2035 configuration would be the same as for Alternative 2a, as shown in Figure 4-6.

4.4.8 Alternative 5—SRPA Contingent Pump and Treat

Alternative 5 is a contingent remedy comprised of removal, ex situ treatment, and disposal of contaminated SRPA groundwater. A pump and treat remedy is identified as only contingent and is not defined as part of a comprehensive OU 3-14 remedy for the following reasons:

1. The model is conservative and overpredicts current Sr-90 concentrations in the aquifer. If Sr-90 concentrations meet MCLs prior to 2095, then no SRPA remedy would be necessary.

2. OU 3-14 remedial actions on the tank farm soil, in combination with OU 3-13 remedial actions on the perched water and/or interbeds, may reduce Sr-90 flux to the aquifer sufficiently that Sr-90 concentrations will meet the Idaho groundwater quality standards prior to 2095. In this case, no action on the groundwater would be necessary due to the success of the remedies applied to other media.

Contingent pumping and treatment of the SRPA would be implemented based on decision rules that would be established in the OU 3-14 ROD. The decision rules would identify requirements to determine whether SRPA RAO I would be met. If monitoring of perched water indicated that the RAO would not be met, Alternative 5 would be implemented.

The numerical modeling predicted that Sr-90 is the only COC that would exceed the SRPA MCL in the year 2095. The modeling predicted that the area of contamination above the MCL would be confined to the INTEC footprint. Natural attenuation from radioactive decay, dispersion, sorption, and dilution prevented the 8-pCi/L isopleth from extending beyond the southern INTEC fence line in the year 2095. This suggests the Sr-90 plume should be contained within the INTEC footprint without taking remedial actions.

The numerical modeling also predicted Tc-99 would briefly exceed the SRPA MCL in 1999 but would be approximately two orders of magnitude below the MCL in the year 2095. Current measured Tc-99 concentrations in the aquifer are above the MCL, but the high mobility of Tc-99 in the subsurface should decrease the Tc-99 concentration to levels below the MCL prior to 2095, because of the dispersion and dilution within the aquifer.

The groundwater pumping option for Alternative 5 would clean up Sr-90 in the SRPA resulting from INTEC releases to meet State of Idaho groundwater quality standards in 2095 and after, thereby meeting RAO I. Alternative 5 requires the use of extraction wells, groundwater pumping, piping extracted water to pump stations and to treatment units, and discharge of the treated water to a new injection well. Requirements, conceptual design, and sequence of activities for Alternative 5 are described below.

4.4.8.1 Requirements. Requirements for the SRPA contingent pump and treatment options were derived from ARARs, TBCs, and RAOs identified previously and BMEPs related to pump and treat and disposal, as follows:

1. The pump and treat and disposal system must meet constraints of the tank farm closure schedule as discussed in Section 3.

   a. Basis: BMEP, technical implementability.

2. The pump and treat and disposal system must meet ARARs and TBCs identified in Table 4-6.

   a. Basis: Regulatory requirements.

3. Reinjected effluents must meet MCLs for specific radionuclides.

   a. Basis: IDAPA 58.01.11.

4. A hazardous waste determination must be made on any disposed residue, such as filters or ion exchange media.

   a. Basis: IDAPA 58.01.05.006 (40 CFR 262.11).

5. The extraction well(s) location, depth, and pumping rates must be designed to clean up Sr-90 originating from INTEC sources by 2095 and after to applicable State of Idaho groundwater standards.

   a. Basis: RAO 1b.

6. The pump and treat and disposal system must limit exposures to future site workers to less than 100 mrem/yr.

    a. Basis: DOE 5400.5, PRD-183, DOE Order 440.1A, DOE 435.1

4.4.8.1.1 Assumptions—In addition to the T&FRs, the following assumptions were made to develop the SRPA pump and treat conceptual design:

1. The treatment plant is assumed to have a 2% annual replacement rate, equating to an operational life of 50 years for capital equipment. Resin life is estimated at 15 years for the zeolite.

    a. Basis: BMEP.

2. Solid secondary wastes will be disposed of at an ICDF-equivalent on-Site or off-Site disposal facility.

    a. Basis: OU 3-13 ROD (DOE-ID 1999); ICDF WAC (DOE-ID 2005b); ICDF planned closure date of 2013.

3. The system will be fully automatic with appropriate instrumentation and programmable logic controllers (PLCs) or equivalent.

    a. Basis: BMEP.

4. The system will include leak detection and automatic shutoff for well pumping, surge tank overflow, and sumps, as appropriate.

    a. Basis: BMEP.

5. The system will be housed in a building to provide containment/confinement, including heating, ventilating, and air conditioning (HVAC) and a sump.

    a. Basis: BMEP for freeze protection.

    b. Basis: BMEP for single-zone confinement at low-level waste (LLW) facilities.

6. Utilities, including electricity, potable water, and air, need to be provided.

    a. Basis: BMEP, need of utilities.

7. Ion exchange columns will be regenerated.

    a. Basis: BMEP, cost of resin and disposal prohibitive.

8. Regenerant storage will provide at least one batch each of anion and cation spent regenerant.

    a. Basis: BMEP.

9. Evaporation ponds will have storage capacity for at least one volume of anion and cation spent regenerant.

    a. Basis: BMEP.

4.4.8.2 Conceptual Design. Results of numerical modeling performed to determine a pumping strategy to meet groundwater quality standards in 2095 and after, everywhere in the SRPA affected by INTEC releases (i.e., RAO I), are provided in Appendix A and are described in Section 3. The well locations determined in the computer simulations are shown in Figure 3-15. This conceptual pumping design would be optimized during remedial design.

The most efficient conceptual pumping design modeled used two pumping periods:

1. 550 gpm total from three wells (183 gpm per well) 2077-2102

2. 183 gpm total from two wells (92 gpm per well) 2102-2123. The southernmost production well would be closed in 2102, and the pumping rate from the remaining two wells would be reduced to 92 gpm/well.

The system is shown in Figures 4-12 through 4-15, including the yard plan, building layout, process flow diagram (PFD), and piping and instrument diagram (P&ID). Figure 4-14 shows the conceptual PFD. For simplicity, Figure 4-15 shows the equipment needed to process the water from one well. Because there are a maximum of three wells used at any time, there would be three treatment modules, each having the equipment shown on the PFD.

The SRPA water feed constituents are based upon average values from several wells around the INTEC. Only the major cations/anions are shown for brevity. The complete ionic values balance by mass and charge is available in project files (EXCEL documents). A minor adjustment in HCO_3^- was required to obtain a charge balance.

The extracted water is pumped to a surge/storage tank. This tank is pumped through backwashable filters to remove undissolved solids, nominally 5 μm. Filters are backwashed directly to the evaporation pond upon reaching a predetermined pressure loss. There are two filters, one is backwashed while the other is being used. After filtration, the water is treat`ed in a cation exchange column. The cation column uses the natural zeolite chabazite to remove total Sr and may remove some of the other cations. The effluent from the cation column is monitored and pumped to a new injection well as shown in Figure 4-12. It was assumed for the PFD that the decontamination factor, i.e., the ratio of the influent/effluent concentrations, for the other cations was small and for Sr is 100, although this is low compared to vendor-supplied values as shown in Figure 4-16. The predominant competing cations Ca^{+2} and Mg^{+2} break through very early in this resin, leading to a large Sr capacity as shown in Figure 4-17. Column testing would be required to obtain bed volumes and, hence, accurate design.

This is a lead-lag configuration where breakthrough of the lead column initiates regeneration and switches the lag column to lead. Figure 4-15 does not show all of the piping and fittings, but this is a fairly common mode and title design would provide the configuration details. The regeneration using NaCl is triggered by breakthrough of β particles at 0.546 MeV for Sr-90. Regeneration steps for a generic zeolite are shown in Table 4-10.

Table 4-11 shows dimensions for columns and other equipment. A large salt tank is used to feed regenerant and is saturated at 26%. Salt is received via truck and transferred to the salt tank via screw conveyor system. Upon reaching the useful resin life, the columns are designed to be removed with the resin and replaced.

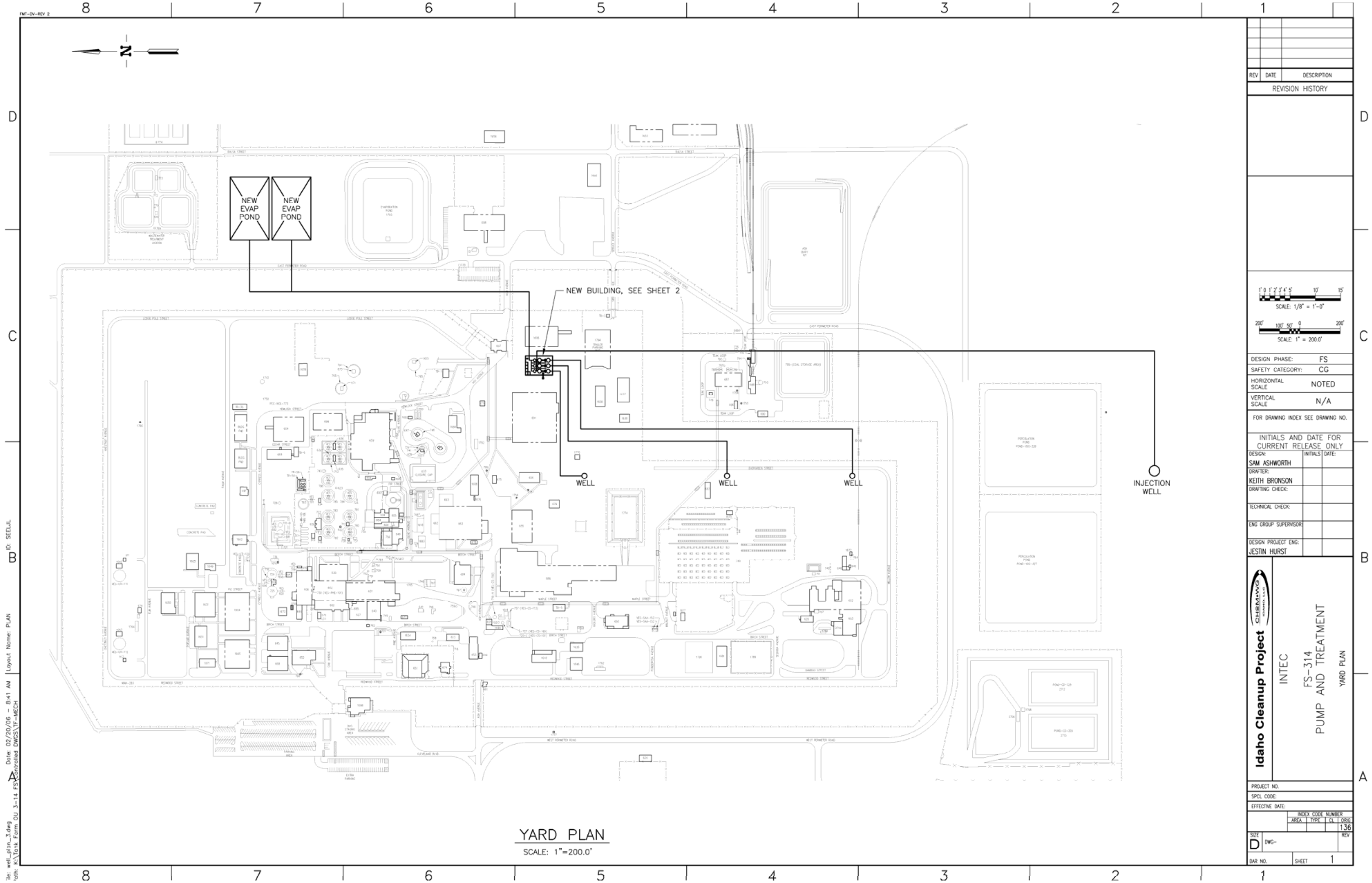


Figure 4-12. Yard plan for SRPA cleanup pumping and treatment.

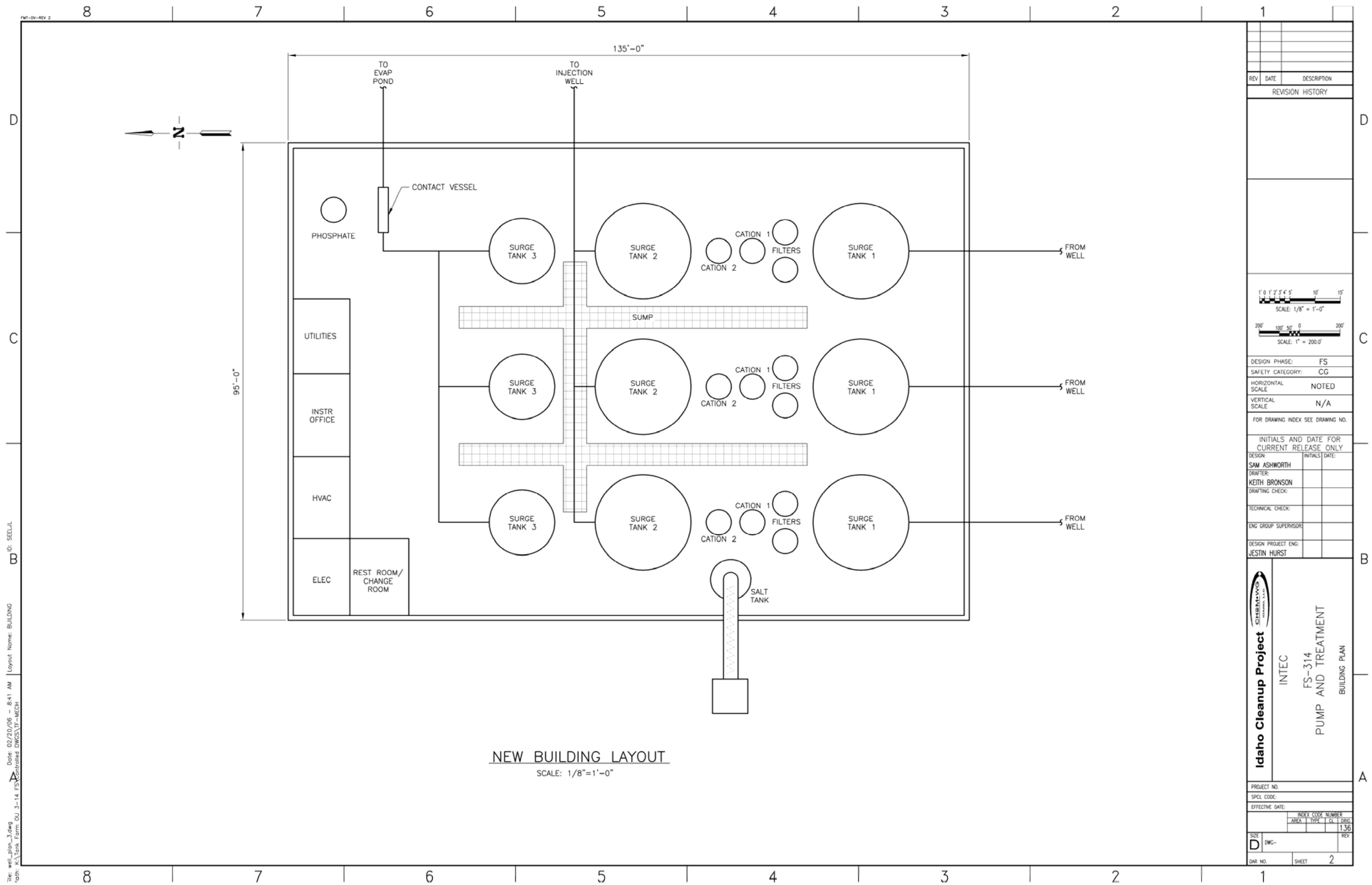
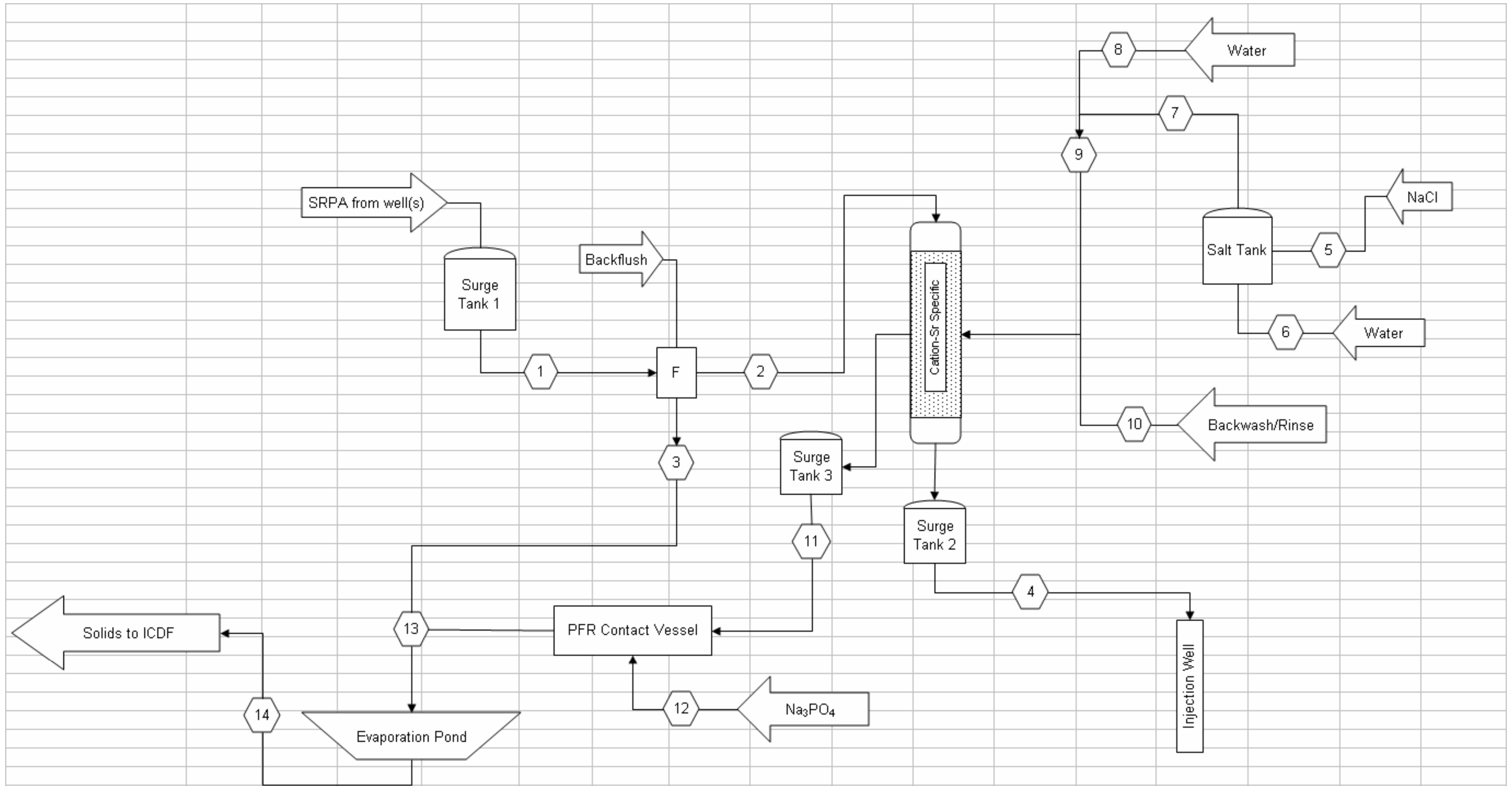


Figure 4-13. Layout for SRPA cleanup pumping and treatment.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Stream	SRPA	Filtered SRPA	Filter Backwash	Cation IX Outlet	NaCl Supplied	Makeup Water	Cation (raw) Regenerant	Dilution Water	Cation Regenerant	Backwash & Rinse	Cation IX Spent	Solution Adjustment	Evap Pond Feed	Solids to ICDF
Flow, gpm	550	550	0.02	550	N/A	N/A	0.09	0.17	0.26	0.33	0.59	0.014	0.63	0.16
TSS, mg/L	50	0.5	1.20E+06	0.5	N/A	0	0	0	0	0	0.5	0.00	4.35E+04	N/A
lb/batch	N/A	N/A	1000.8	N/A	1.11E+04	3.17E+04	4.29E+04	6.94E+04	1.11E+05	1.33E+05	2.44E+05	6.43E+03	2.51E+05	1.34E+07
gal/batch	N/A	N/A	100	N/A	1.16E+03	4.28E+03	4.28E+03	8.32E+03	1.26E+04	1.59E+04	2.85E+04	7.01E+02	2.93E+04	1.40E+06
SpG	1	1	1.20	1	1.15	1	1.2	1	1.06	1	1.03	1.1	1.03	1.15
Na_3PO_4, mEq/L	0	0	0	0	0	0	0	0	0	0	0	2.01E+03	4.66E+01	N/A
Radionuclides, pCi/L														pCi/kg
$^{90}Sr^{+2}$	40.5	40.5	2.43E+02	0.405	N/A	N/A	N/A	N/A	0		3.75E+04	0	3.53E+04	3.12E+04
Cations, mEq/L														mg/kg
Ca	2.95E+00	2.95E+00	1.77E+01	2.92E+00	N/A	N/A	N/A	N/A	0		2.73E+01	0	2.64E+01	4.66E+02
K^+	9.37E-02	9.37E-02	5.62E-01	9.27E-02	N/A	N/A	N/A	N/A	0		8.67E-01	0	8.36E-01	2.88E+01
Mg^{+2}	1.46E+00	1.46E+00	8.73E+00	1.44E+00	N/A	N/A	N/A	N/A	0		1.35E+01	0	1.30E+01	1.39E+02
Sr^{+2}	8.28E-03	8.28E-03	4.97E-02	8.28E-05	N/A	N/A	N/A	N/A	0		7.67E+00	0	7.21E+00	2.87E+02
Na (C-ion)	1.22E+00	1.22E+00	7.29E+00	1.27E+00	N/A	N/A	5333	N/A	1812		2.03E+04	0	1.91E+04	3.89E+05
Anions, mEq/L														
As^{-3}	9.92E-02	9.92E-02	5.95E-01	9.82E-02	N/A	N/A	N/A	N/A	0		2.43E-01	0	2.50E-01	5.52E+00
HCO_3^-	2.91E+00	2.91E+00	1.75E+01	2.89E+00	N/A	N/A	N/A	N/A	0		7.13E+00	0	7.34E+00	3.96E+02
NO_3^-	3.97E-01	3.97E-01	2.38E+00	3.93E-01	N/A	N/A	N/A	N/A	0		9.71E-01	0	9.99E-01	5.48E+01
SO_4^{-2}	6.62E-01	6.62E-01	3.97E+00	6.56E-01	N/A	N/A	N/A	N/A	0		1.62E+00	0	1.67E+00	7.07E+01
Cl (C-ion)	1.66	1.66E+00	9.97E+00	1.70E+00	N/A	N/A	5333	N/A	1812		2.04E+04	0	1.92E+04	6.10E+05

Figure 4-14. Process flow diagram (PFD) for SRPA cleanup pumping and treatment.

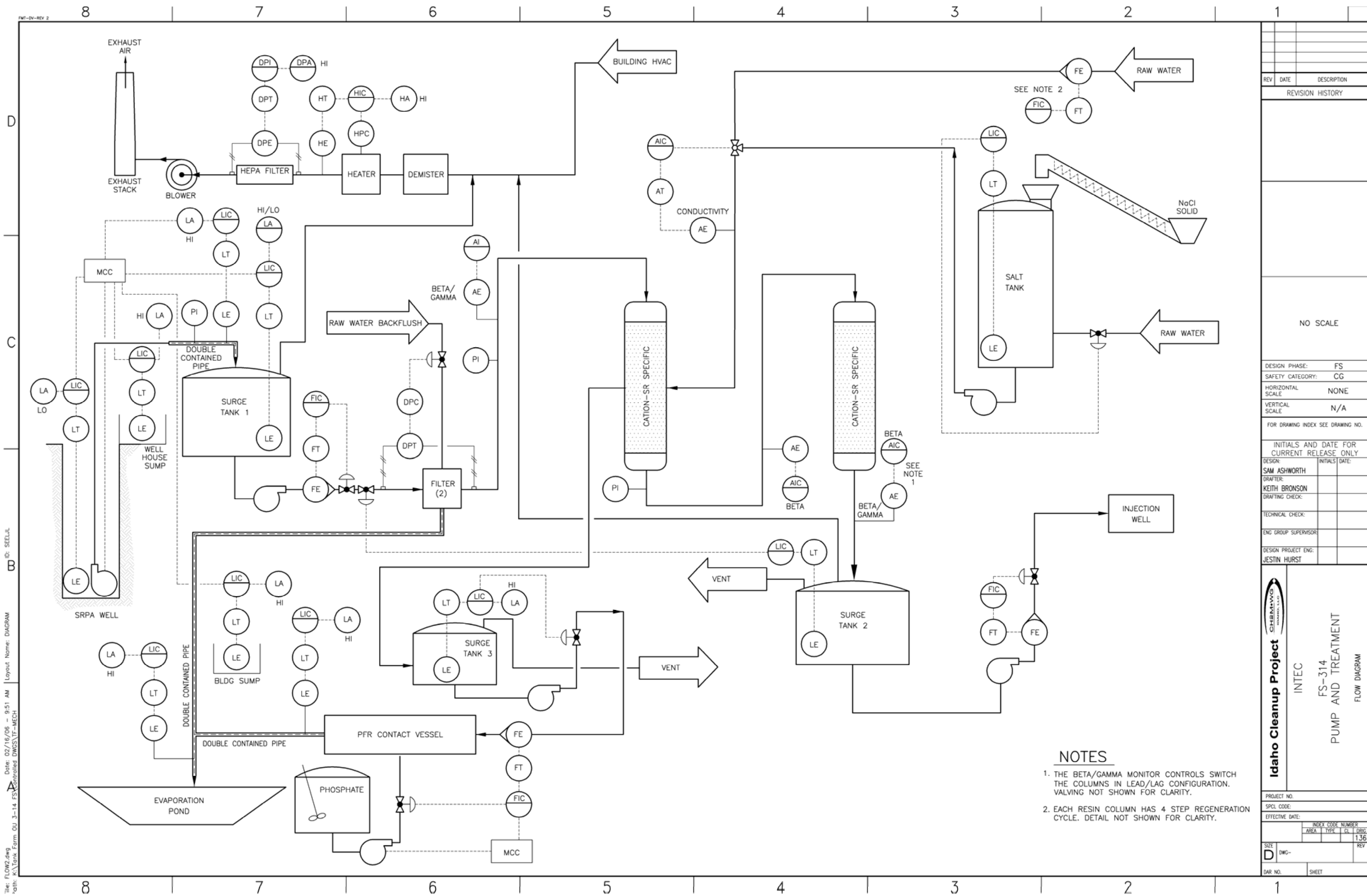


Figure 4-15. Piping and instrumentation diagram (P&ID) for SRPA cleanup pumping and treatment.

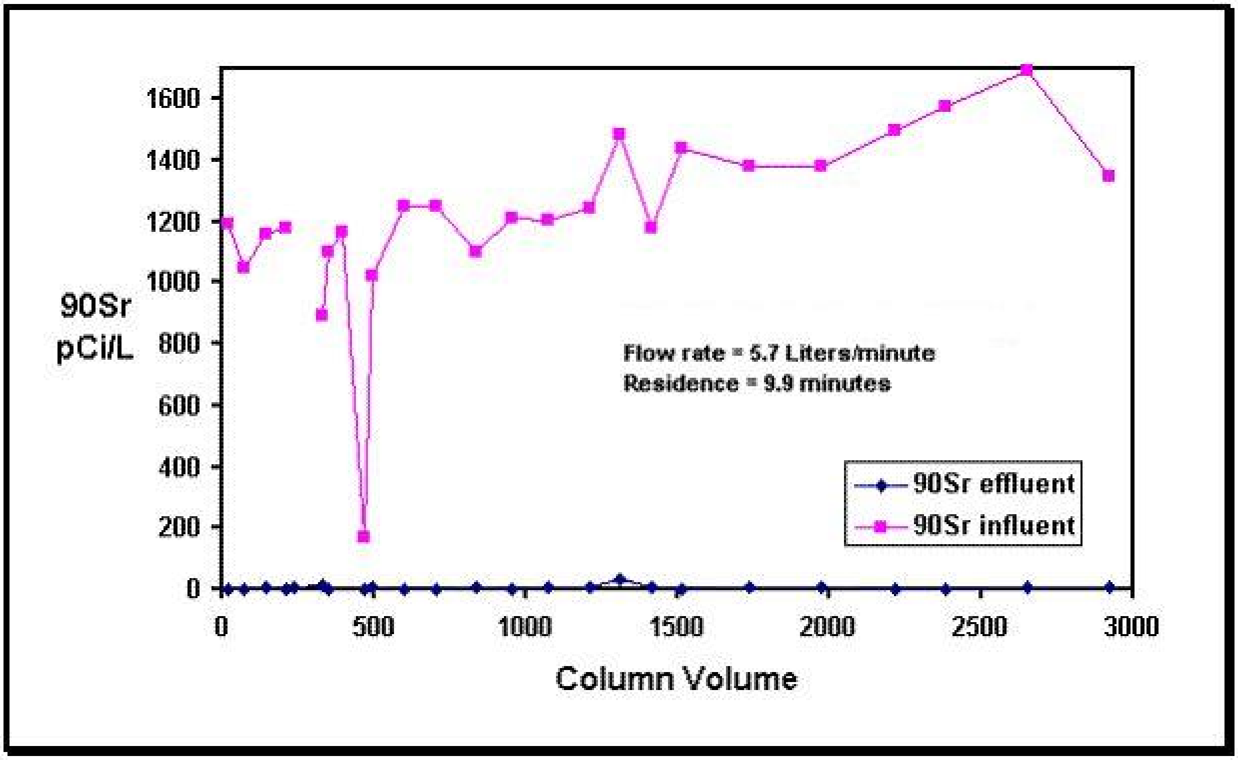


Figure 4-16. Sr removal by chabezite.

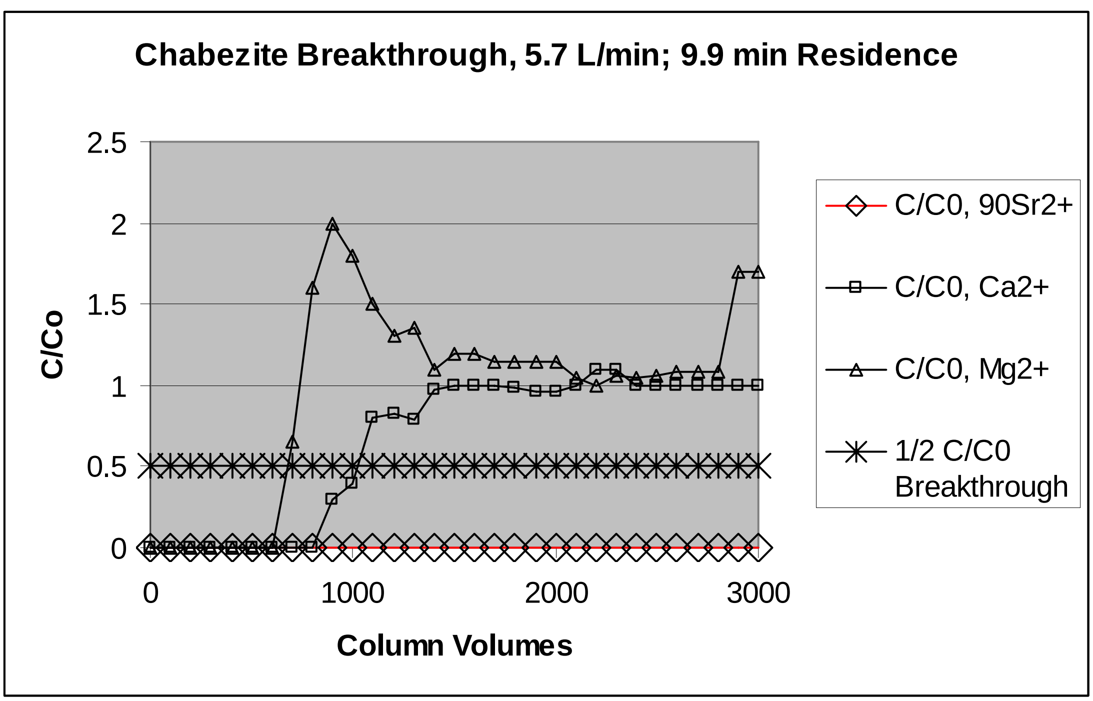


Figure 4-17. Chabezite breakthrough curve.

Table 4-10. Ion exchange regeneration for containment pumping and treatment.

Zeolite Generic Regeneration

Step	Function	Time (min)	Rate[a] (gpm/ft^2)	Rate (gpm)	Amount (lb/ft^3)	Amount[b] (lb)	Amount (gal)
1	Backwash	27	6	137.5	209	9.29E+04	1.11E+04
2	Brining	183	1	23	25	1.11E+05	1.26E+04
3	Slow rinse	24	1	23	31	1.39E+04	1.67E+03
4	Fast rinse	30	1.5	34	58	2.58E+04	3.09E+03
	Totals	265	N/A	N/A	N/A	2.44E+05	2.85E+04
	NaCl (lb/day)					3.31E+02	

a. All flows are back-flow, i.e., counter to the normal flow. This may require appropriate resin containment.
b. Pounds of brining is total; 10% is salt (NaCl).

Table 4-11. Conceptual parts list for pump and treat.

Equipment	Quantity	Rate (peak, gpm, cfm)	Rate (average)	Size (gal)	Size (D' x L')		Type	Material
Cation column	6	183	183	1,667	5	10	Removable	FRP
Cation resin	N/A	N/A	N/A	1,111	N/A	N/A	Chabezite, cationic zeolite	N/A
Salt tank	1	23	0.09	3,000	8	9	Vendor recommendation	Lined steel
Phosphate tank	1	9	1.45E-02	800	5	6	Tank with static mixer	Steel
Filter	6	183	183	N/A	5.00	8.00	Backwashable or cross-flow	Vendor
Contact vessel	1	146	0.63	146	1.61	10	Static mixer in pipe	Lined steel
Surge tank 1	3	183	183	50,000	19	23	Standard, receive SRPA	Steel
Surge tank 2	3	183	183	50,000	19	23	Standard, effluent to injection well	Lined steel
Surge tank 3	3	137.5	0.59	16,000	13	16	Regenerant	Lined steel

Table 4-11. (continued).

Equipment	Quantity	Rate (peak, gpm, cfm)	Rate (average)	Size (gal)	Size (D' x L')		Type	Material
Piping	N/A	Ranges, see PFD, Figure 4-1			0.33	33,400	Double pipe or in lined trench outside containment	Steel
Recovery well	3	183	183	600 ft in depth to SRPA			Standard includes pump house	Steel
Injection well	1	183	183	600 ft in depth to SRPA			N/A	Steel
Salt conveyor (ton/batch, ton/yr)	1	6	245	N/A	N/A	N/A	Screw conveyor	Steel
Pumps	N/A	See PFD/P&ID, Figures 4-14, 4-15						
HVAC (cfm)	N/A	23,000	23,000	N/A	N/A	N/A	Single zone with HEPA, demister, and heater	Sheet metal
Instrumentation	N/A	See P&ID					Panel mount PLC NEMA (see P&ID), remote capability	N/A
Vessel vent	N/A	N/A	N/A	N/A	N/A	N/A	Tie-in to HVAC	Steel
Building	1	N/A	N/A	95 (W)	135 (L)	35 (H)	Butler, heated, normally unmanned, removable roofing for crane access	Sheet metal
Containment (building floor) min	1	N/A	N/A	95(W)	135 (L)	0.57 (H)	Coated concrete, sump with level control and alarm	Epoxy
Evaporation pond	2	138	0.63	225	364	3.84	Lined	HDPE

N/A = not applicable.
PLC = programmable logic controller.
NEMA = National Electrical Manufacturer's Association.
FRP = fiberglass-reinforced plastic.
HDPE = high-density polyethylene.

The regenerant solution, salt water including ions and radionuclides, is pumped to a new evaporation pond via a contact chamber for concentration/precipitation. The contact chamber, deemed a plug flow reactor, is basically a pipe with a static mixer inserted inside. Although not required, it is desirable to make the Sr-90 chelate or precipitate with phosphate to minimize air emissions from the ponds. There would be two ponds, one receiving while the other is being dried and the residue removed to an ICDF-equivalent on-Site or off-Site disposal facility. The dried salts meet the ICDF WAC for everything except sodium on a mass basis. An alternative to two new ponds would be to use the existing storm water pond shown to the right in Figure 4-12.

Secondary wastes will be generated. The pre-ion exchange filters will be LLW and disposed of at an ICDF-equivalent on-Site or off-Site disposal facility. The filters are estimated to last 5 years. The filter type has not been specified, but, if cross-flow types are used, the filter life could be longer. Because of the low-level nature of this system, the HVAC HEPA is expected to last greater than 10 years. However, the HEPA prefilters will have frequent changeout and will be LLW. Other secondary wastes include the spent ion exchange columns and failed equipment, both LLW. All solid secondary waste types would be disposed of at an ICDF-equivalent on-Site or off-Site disposal facility. All liquid secondary wastes, including the ion exchange regenerants, would be disposed of in an evaporation pond. The solid residuals would be removed from the pond periodically and disposed of at an ICDF-equivalent on-Site or off-Site disposal facility.

Treatability testing is recommended for ion exchange treatment of the groundwater. There has been some previous treatability testing on similar groundwater from Test Area North (Garn et al. 1997) for Sr-90. However, little could be found concerning the details of these resins. Therefore, the resins chosen will need to be validated. It is reasonably certain that chabezite will perform as intended. Treatability testing will consist of determining the bed volumes to breakthrough of groundwater. It is also desirable to test the β/γ instrumentation during treatability for the chabezite. Testing should also include proposed filters.

4.4.8.3 Monitoring. Monitoring for the SRPA is assumed to be addressed under the existing OU 3-13 Group 5 remedy, which would become part of the OU 3-14 remedial response via the OU 3-14 ROD. The monitoring under Group 5 is adequate for OU 3-14 monitoring and includes a more extensive list of radionuclides every 2 years until 2015 and then every 5 years beginning in 2015 (DOE-ID 2004). No additional wells are assumed to be required. In addition to the Group 5 monitoring, water levels would be monitored in pumping wells and selected monitoring wells for Alternative 2 to determine capture zones of the pumping systems. Specific monitoring for the pump and treat system is shown in the P&ID, including systems for process control and leak detection in sumps, containment and encased piping.

4.4.8.4 Operations and Maintenance. Operation and maintenance of the SRPA pump and treat system is estimated at 40 hr/month for Alternative 5. Routine tasks include filling the salt tank; monitoring for alarms; maintaining pumps, valves, instrumentation, and miscellaneous equipment; and routine walk-through. The system would be designed for automated operation and remote monitoring capability.

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5. DETAILED ANALYSIS OF ALTERNATIVES

Remedial alternatives developed in Section 4 and summarized in Table 4-7 are analyzed in detail in this section. Results of this analysis will form the basis for comparing alternatives in Section 6 and for preparing the Proposed Plan. After review and comment on the Proposed Plan, a final remedy for the Operable Unit (OU) 3-14 sites will be selected and the Record of Decision (ROD), including a response to public comments, will be prepared.

5.1 Introduction

This section describes the purpose of the detailed analysis and provides an overview of the CERCLA evaluation criteria.

5.1.1 Purpose of the Detailed Analysis

The remedial action alternatives developed in Section 4 are analyzed in detail against the CERCLA criteria to form the basis for selecting a final remedial action. The intent of this analysis is to present sufficient information to support preparation of the Proposed Plan and to allow the risk managers (EPA, DEQ, and DOE Idaho) to select an appropriate remedy.

Alternatives are evaluated with respect to the two threshold and five balancing CERCLA criteria outlined in 40 CFR 300.430(e)(9)(iii) and as discussed in Section 5.1.2. This evaluation is the basis for determining the ability of a remedial action alternative to satisfy CERCLA remedy selection requirements.

5.1.2 Overview of the CERCLA Evaluation Criteria

The CERCLA evaluation criteria include technical, administrative, and cost considerations; compliance with specific statutory requirements; and state and community acceptance. Overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs) and other information to be considered (TBCs) are categorized as threshold criteria that any viable alternative must meet. Long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost are considered balancing criteria upon which the detailed analysis is primarily based. State and community acceptance are evaluated following comment on the remedial investigation/feasibility study (RI/FS) report and the Proposed Plan and are addressed as a final decision is made and the ROD is prepared. Each criterion is described below.

5.1.2.1 Overall Protection of Human Health and the Environment. Alternatives will be assessed to determine whether they can adequately protect human health and the environment, in both the short and long term, from unacceptable risks posed by contaminants present at the tank farm, by eliminating, reducing, or controlling exposures as established during the development of remedial action objectives (RAOs) and preliminary remediation goals (PRGs) consistent with 40 CFR 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of the other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Modeling results compiled from the OU 3-14 baseline risk assessment (BRA) report and from Appendix A of this FS are used to evaluate whether each alternative can meet RAO II. The maximum Sr-90 concentration in 2095 in the model domain and the date at which the maximum contaminant level (MCL) is attained are reported for each alternative. The effects of possible OU 3-13 Group 4 remedies, including reducing anthropogenic water by 50% by 2008 and lining the Big Lost River by 2010, are also accounted for.

5.1.2.2 Compliance with ARARs and TBCs. Alternatives will be assessed to determine whether they meet ARARs and TBCs identified for that alternative or a basis exists for invoking one of the waivers cited in 40 CFR 300.430(f)(l)(ii)(C), as listed below:

(1) The alternative is an interim measure and will become part of a total remedial action that will attain the applicable or relevant and appropriate federal or state requirement;

(2) Compliance with the requirement will result in greater risk to human health and the environment than other alternatives;

(3) Compliance with the requirement is technically impracticable from an engineering perspective;

(4) The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach;

(5) With respect to a state requirement, the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state.

5.1.2.3 Long-term Effectiveness and Permanence. Long-term effectiveness and permanence are criteria to evaluate the anticipated ability of the alternatives to maintain reliable protection of human health and the environment for the duration of risk above allowable levels once the RAOs are met. Alternatives will be assessed for the long-term effectiveness and permanence they afford along with the degree of certainty that the alternative will prove successful. Factors that may be considered in this assessment include the following:

- The magnitude of residual risk from untreated waste or treatment residuals remaining at the conclusion of the remedial activities, including their volume, toxicity, and mobility

- The adequacy and reliability of controls such as containment systems and institutional controls necessary to manage treatment residuals and untreated waste (for example, this factor addresses uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap or treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement).

5.1.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment. The degree to which the alternatives employ treatment or recycling that reduces toxicity, mobility, or volume will be assessed, including how the treatment is used to address the principal threats posed by the release sites. Factors that will be considered, as appropriate, include the following:

- Treatment or recycling processes that the alternatives employ and the materials that they will treat

- The amount of hazardous substances, pollutants, or contaminants that will be destroyed or recycled

- The degree of expected reduction in toxicity, mobility, or volume of the waste because of the treatment or recycling and the specification of which reductions are occurring
- The degree to which the treatment is irreversible
- The type and quantity of residuals that will remain following treatment, taking into consideration the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents
- The degree to which treatment reduces the inherent hazards posed by the principal threats at the release sites.

5.1.2.5 Short-term Effectiveness. Short-term effects during implementation of the remedial action will be assessed, including the following:

- Short-term risks that might be posed to the community
- Potential risks or hazards to workers, and the effectiveness and reliability of protective measures
- Potential environmental effects and the effectiveness and reliability of mitigative measures
- Time until protection is achieved.

5.1.2.6 Implementability. The ease or difficulty of implementing the alternatives will be assessed by considering the following types of factors, as appropriate:

- Technical feasibility, including the technical difficulties and unknowns associated with constructing and operating the technology, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy
- Administrative feasibility, including activities required to coordinate with other offices and agencies and the ability and time needed to obtain any necessary approvals and permits for off-Site actions from other agencies
- Availability of required materials and services.

5.1.2.7 Cost. The types of costs assessed include the following:

- The Federal Facility Agreement and Consent Order (FFA/CO) (DOE-ID 1991) management and oversight costs, including 5-year reviews, which would be incurred primarily by the Idaho Cleanup Project
- Remedial design and construction documentation costs, including remedial design, construction management and oversight, remedial design and remedial action document preparation, and reporting costs
- Construction costs, including capital equipment, general and administrative costs, and construction subcontract fees
- Operating and maintenance costs
- Equipment replacement costs
- Surveillance and monitoring costs.

Contingency was estimated independently for each alternative. EPA guidance (EPA 2000) distinguishes between scope contingency and bid contingency costs. Scope contingency costs represent risks associated with incomplete design and include contributing factors such as limited experience with technologies, additional requirements because of regulatory or policy changes, and inaccuracies in defining quantities or characteristics. Bid contingency costs are unknown costs at the time of estimate preparation that become known as remedial action construction proceeds. Bid contingencies represent reserves for quantity overruns, modifications, change orders, and claims during construction. The EPA guidance states that bid contingencies should be added to construction costs and typically range from 10 to 20%.

Considering the EPA (2000) cost contingency guidance for each of the alternatives, a representative contingency was selected within the range provided based on the complexity and size of the project and the inherent uncertainties related to the remedial technologies.

Life-cycle costs are presented as net present value (NPV) FY 2006 dollars for capital, operating and maintenance, and periodic costs for each alternative. Escalation was applied as directed by DOE Order 430.1B, "Real Property Asset Management." Guidance was provided by U.S. Department of Energy (DOE) Headquarters, Office of Project and Fixed Asset Management, *Departmental Price Change Index, FY-99 Guidance, Anticipated Economic Escalation Rates*, January 1997 update (DOE 1997).

The alternative cost estimates are for comparison purposes only and are not intended for budgetary, planning, or funding purposes. Estimates were prepared to meet the -30 to +50% range of accuracy recommended in EPA (1988) CERCLA guidance. Detailed cost estimate backup is provided in Appendix B.

5.1.2.8 State Acceptance. This assessment evaluates the technical and administrative issues and concerns the DEQ may have regarding each of the alternatives. This criterion will be addressed in the Proposed Plan and ROD after comments are received.

5.1.2.9 Community Acceptance. This assessment evaluates the issues and concerns the public may have regarding each of the alternatives. As for state acceptance, this criterion will be addressed in the ROD after public comments on the Proposed Plan are received.

5.2 Detailed Analysis of Alternatives

5.2.1 Alternative 1—Institutional Controls and O&M and Monitoring

5.2.1.1 Overall Protection of Human Health and the Environment. The overall protection of human health provided by this alternative is high as long as institutional controls are in effect. Human health risks exceeding allowable levels are identified in the OU 3-14 RI/BRA. These health risks include external radiation exposure to current and future workers via Cs-137 present in tank farm soil; the risks also include exposure to Sr-90 via groundwater ingestion by future residents outside the industrial use area. Passive institutional controls would remain in effect as long as these risks remain above allowable levels. Human health risks would be eliminated by passive institutional controls, because site access restrictions would eliminate the exposure pathways. If institutional controls end, the risks would be the same as those identified in the RI/BRA, because no remediation or permanent engineered access controls would be implemented.

Potential occupational injury or external radiation exposure risks would exist for onsite workers conducting environmental monitoring and maintenance activities during implementation of institutional controls. These risks would be minimized administratively through radiological engineering operational controls, including as low as reasonably achievable (ALARA) reviews, health and safety procedures, and safe work practices. Risks to the public would be eliminated by institutional controls, because general public access to the tank farm sites would be restricted.

Surface soil RAOs III and IV can both be met, as long as institutional controls remain in effect, by continuing existing access restrictions and administrative controls. However, Cs-137 would remain in soil inside the tank farm boundary at concentrations above the future worker PRG after 2095.

Environmental risks would not be reduced or eliminated by institutional controls. RAO V would not be met, because institutional controls do not include the existing facility operation and maintenance (O&M) practices, including "weed and other controls used to discourage a natural habitat," as described in the OU 3-14 BRA, Section 9.4 (DOE-NE-ID 2006). Internal exposures of ecological receptors to radionuclides could exceed allowable levels under this alternative.

Table 5-1 summarizes results of groundwater modeling for Alternative 1. Groundwater RAO I would be met by restricting access and continuing existing administrative controls through 2095. Groundwater RAO II would not be met, because concentrations of Sr-90 in SRPA groundwater are predicted to exceed the State of Idaho groundwater quality standard in 2095 and after. The concentration of Sr-90 is predicted to be 19 pCi/L in 2095, and concentrations would not reach the MCL of 8 pCI/L until 2129 under RI/BRA base case conditions. OU 3-13 Group 4 remedies, including reducing anthropogenic water by 50% in 2008 and lining the Big Lost River in 2010, would reduce the concentration of Sr-90 in 2095 to 13.5 pCi/L and would reduce the time to attainment of the MCL to 2115.

Table 5-1. Groundwater modeling results for Alternative 1.

Remedy Description/ Alternative	Peak Sr-90 Concentration in 2095, pCi/L	Date MCL is Attained	Comments
1	19	2129	BRA base case model run.
1 + OU 3-13 Group 4	13.5	2115	Includes benefits from the Group 4 perched water remedy (reducing anthropogenic water and lining the Big Lost River).

5.2.1.2 Compliance with ARARs and TBCs. Table 5-2 summarizes compliance with ARARs and TBCs for Alternative 1. Idaho Administrative Procedures Act (IDAPA) 58.01.01.650 and 58.01.01.651 relating to control of fugitive dust emissions during O&M of the existing surface water controls would be met by implementing control measures that would be defined in the remedial action work plan. Other Clean Air Act and Idaho air regulations would be met by evaluating emissions from remediation activities during remedial design and implementing controls as required to meet emission limits. Institutional controls and monitoring performed under this alternative would be required to meet the ARARs.

Table 5-2. Summary of applicable or relevant and appropriate requirements for Alternative 1.

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to CERCLA related construction and maintenance activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. Would be met, because emissions would be below allowable levels.
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		Applies to CERCLA-related construction and maintenance activities. The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.92, "Standard"		A		Applies to O&M of existing surface water controls and of institutional controls. Would be met, because emissions would be below allowable levels.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Applies to O&M of existing surface water controls and of institutional controls. Would be met, because emissions would be below allowable levels.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			Applies to O&M of existing surface water controls and of institutional controls. Would be met, because emissions would be below allowable levels.

Table 5-2. (continued).

Requirement (Citation)	ARAR Type			Comments
	Action Specific	Chemical Specific	Location Specific	
“Rules for Control of Fugitive Dust,” and “General Rules,” IDAPA 58.01.01.650 and 58.01.01.651	A			Applies to O&M of existing surface water controls and of institutional controls. Would be met, by control measures on O&M activities, implemented through remedial action work plan.
Idaho Ground Water Quality Rules:				
“Ground Water Quality Rule,” IDAPA 58.01.11	A			Would not be met, because Sr-90 concentrations in the SRPA resulting from OU 3-14 releases are predicted to exceed applicable State of Idaho groundwater quality standards in 2095 and beyond.
To-Be-Considered Requirements				
“Radiation Protection of the Public and the Environment,” DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to tank farm soil during institutional control period. Would not be met after 2095, because Sr-90 concentrations in the SRPA are predicted to exceed risk-based levels.
“Radioactive Waste Management,” DOE Order 435.1	TBC			Applies to radioactive waste generated from the O&M activities. Would be met by administrative controls implemented through remedial action work plan.
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to tank farm soil during institutional control period as long as contamination remains in place above levels that allow for unrestricted use and access. Would be met by implementing the approach defined in the RD/RA work plan.

Key:
A = applicable requirement.
TBC = to be considered.

Clean Air Act and Idaho air regulations would be met during implementation of institutional controls and O&M of the surface water controls. Levels of contaminants emitted are expected to be below occupational exposure levels, based on results reported in Section 7.1.1 of the OU 3-14 RI/BRA (DOE-NE-ID 2006). The OU 3-14 BRA used air pathway results from the OU 3-13 BRA, because no new data were available for the 0 to 6-in. soil depth interval. The OU 3-13 BRA evaluated risks to both future workers and future residents on the tank farm via inhalation and found carcinogenic risks and hazard quotients both to be below 1E-13 and 1E-06, respectively. These results indicate that the Clean Air Act and Idaho air regulations would be met by Alternative 1.

The 40 CFR 61.92, which prohibits emissions of radionuclides to the ambient air from DOE facilities to any member of the public greater than an effective dose equivalent of 10 mrem/yr, would be met because OU 3-13 BRA calculations indicated that exposure risks to the public via the air pathway are well below allowable levels. 40 CFR 61.93, "Emission monitoring and test procedures," would be met for the same reason.

Compliance with the Idaho Ground Water Quality Rule (IDAPA 58.01.11) is as described previously for RAO II. The OU 3-14 RI/BRA determined that Sr-90 concentrations will exceed MCLs before and after 2095. This ARAR would, therefore, not be met based on groundwater model predictions.

DOE Order 5400.5 applies as a TBC during the institutional control period. Administrative controls would be used to keep public radiation exposures ALARA. DOE Order 5400.5 would not be met if institutional controls ended before Sr-90 concentrations in SRPA groundwater decreased to risk-based levels.

No location-specific ARARs were identified for this alternative. Overall compliance with ARARs is low, because the Idaho Ground Water Quality Rule would not be met and because DOE Order 5400.5 would not be effective after the end of institutional controls.

5.2.1.3 Long-term Effectiveness and Permanence. Alternative 1 does not provide long-term engineered controls to limit exposures of human and ecological receptors to contaminated soil. No physical controls would be implemented, other than the Tank Farm Interim Action (TFIA) asphalt surfaces. The asphalt surfaces are discontinuous and do not cover all of CPP-96. The asphalt surfaces are assumed to require relatively frequent repair and sealing and are assumed to not limit infiltration into CPP-31 soil after 2095. The asphalt surface covering would not provide an adequate surface barrier to prevent exposures to future workers after 2095.

Alternative 1 would effectively mitigate risks to workers as long as institutional controls, including access restrictions and administrative controls, remain in place. Soil exposure carcinogenic risks identified for future workers would remain unchanged for this alternative if institutional controls end. The direct exposure risk for a worker inside the tank farm boundary would remain above 1E-04 for about 222 years, or until about 2227. This is based on (a) a current 95% upper confidence level Cs-137 concentration of 1,848 pCi/g in the 0 to 4-ft interval, as discussed in Section 7.3.2 of the OU 3-14 RI/BRA report and (b) a calculated concentration of 11.3 pCi/g for a 1E-04 worker exposure.

Direct exposure risks to workers at CPP-15 and CPP-58 would decrease to allowable levels before 2095. Cs-137 concentrations at CPP-15 would decay from the current 95% UCL of 59 pCi/g to the PRG of 11.3 pCi/g in 72 years, reaching the PRG in 2076. Cs-137 concentrations at CPP-58 would decay from the current 95% UCL of 36.8 pCi/g to the PRG in 51 years, reaching the PRG in 2055.

Soil and groundwater risks to hypothetical future residents outside the tank farm via groundwater exposures would be as reported in the OU 3-14 RI/BRA if access restrictions end. Risks to ecological receptors due to radionuclides would not be mitigated by this alternative.

The effectiveness of this alternative for reducing risks to future workers inside the tank farm boundary, and for hypothetical future residents outside the industrial use area, is limited to the duration of institutional controls, when soil and groundwater exposure routes would be interrupted by access restrictions. If institutional controls inside the tank farm boundary and outside the industrial use area end prior to attainment of the soil PRG for Cs-137 and groundwater MCL for Sr-90, respectively, then ARARs and RAOs would not be met. The estimated dates when the soil and groundwater RAOs would be met are beyond the assumed active institutional control period end date of 2095. Alternative 1 would effectively reduce worker risks at CPP-15 and CPP-58 to allowable levels until Cs-137 concentrations in soil had decreased below risk-based levels.

5.2.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment. Treatment would not be implemented with Alternative 1. Some reduction in contaminant mass and concentration would be indirectly achieved through natural radioactive decay of Cs-137 and Sr-90 and other natural attenuation processes, such as dispersion of Sr-90 in groundwater. The toxicity of contaminated materials would also be reduced by a decrease in radionuclide concentration through natural decay and dispersion. Over 200 years would be required for natural radioactive decay alone to reduce the Cs-137 95% upper confidence level concentrations in the 0 to 4-ft interval inside the tank farm boundary to the current worker exposure PRG of 11.3 pCi/g. Less than 80 years would be required to reach the PRG at CPP-15 and CPP-58.

5.2.1.5 Short-term Effectiveness. Institutional controls and O&M and monitoring as described for Alternative 1 are currently implemented, without any significant additional risks to the public or workers. Existing institutional controls would be protective of the public in the short term. The tank farm is not located near any residential population, and effects on outlying communities would be negligible because of the continued access restrictions during the institutional control period that eliminate the exposure risks.

Onsite workers may potentially be exposed to occupational injury or direct radiation while conducting environmental monitoring and TFIA O&M activities. Activities would be conducted by trained personnel in accordance with standard radiological engineering operational procedures, including ALARA review, Health and safety plans (HASPs), and safe work practices to maintain a work environment that minimizes injury or exposure risks. These procedures would ensure that onsite worker exposures would be maintained ALARA.

No additional ecological impacts are anticipated under this alternative. The tank farm sites are located at an active operational facility. Site areas are already disturbed by construction and operational activities and do not support any unique or significant ecological resources. No archaeological or historical sites, wetlands, or critical habitat exist within the tank farm area.

5.2.1.6 Implementability. No implementation concerns are involved with Alternative 1. Institutional controls and monitoring and O&M of the TFIA are currently implemented at INTEC and are easily continued. Implementation of this alternative is technically and administratively feasible. The alternative can be easily implemented using existing institutional control practices and standard sampling and monitoring techniques that are currently used at the INL Site. No specialized equipment or services are required to implement this alternative. Trained personnel, services, and materials to implement the existing institutional controls are readily available. Disposal of sampling waste (i.e., purge water) may pose a minor implementability concern after Idaho CERCLA Disposal Facility (ICDF) and INTEC process equipment waste operations end, currently scheduled for 2013 and 2035, respectively. Uncertainties associated with this alternative are minimal, and no schedule delays would be anticipated with implementation of this alternative.

5.2.1.7 Cost. Capital, O&M, and periodic costs for Alternative 1 through 2095 are provided as NPV in Table 5-3. The base year used in calculating NPV is 2006, with remedy implementation assumed to begin in 2012. OU 3-13 Group 5 groundwater monitoring costs as identified in the current life-cycle baseline are included, because this monitoring would become part of the OU 3-14 SRPA remedy through the OU 3-14 ROD.

Table 5-3. NPV of Alternative 1 through 2095.

Cost Element	NPV (million)
Capital cost	$0
O&M cost	2.66
Periodic cost	0.635
Total through 2095	3.29

5.2.2 Alternative 2a—Institutional Controls, Monitoring, Excavation, and Containment by 2012

5.2.2.1 Overall Protection of Human Health and the Environment. Risks exceeding allowable levels are identified in the OU 3-14 RI/BRA. These risks include external radiation exposure to current workers via Cs-137 contaminated OU 3-14 soil, external radiation exposure to future workers via Cs-137 contaminated soil inside the tank farmboundary, and exposure to Sr-90 via groundwater ingestion by future residents outside the industrial use area. These risks would be eliminated by Alternative 2a as long as institutional controls and monitoring remain effective, as described for Alternative 1. Additional protection of future workers would be provided by the evapotranspiration (ET) cover constructed over the central tank farm by 2012 and over the south tank farm perimeter by 2035. The ET covers would provide a clean earthen barrier greater than the assumed depth of intrusion by a future worker and would be adequate to provide shielding from Cs-137 in underlying contaminated soil. Protection of future workers would also be provided by excavating soil contamination exceeding the future worker PRG from the north tank farm perimeter areas to 4 ft below ground surface (bgs) and backfilling with clean soil. CPP-15 and CPP-58 do not present future worker risks above allowable levels and no soil cover would be constructed over these sites.

The ET cover and backfilled soil would remain in place at the required thickness for at least the time required for Cs-137 to decay to allowable worker exposure levels inside the tank farm boundary, estimated at 222 years. Alternative 2a, therefore, provides engineered controls that would protect future workers from exposure risks due to Cs-137 in OU 3-14 soil for the duration of risk even in the absence of institutional controls.

Table 5-4 summarizes groundwater modeling results for Alternative 2a. Infiltration rates through the 10-acre primary recharge control zone (PRCZ), including the tank farm soil, would be reduced by this alternative, thereby reducing recharge of the northern shallow perched water. Reduction in perched water levels would reduce the driving force for transport of Sr-90 to the SRPA and thereby reduce Sr-90 contaminant concentrations in the SRPA. The ET soil-capillary barrier cover is capable of reducing infiltration rates through the cover to less than 1 mm/yr under average arid climatic conditions, as demonstrated by numerical modeling and field testing discussed in Section 3. Low-permeability asphalt could achieve similar infiltration reduction if maintained.

Table 5-4. Groundwater modeling results for Alternatives 2a and 2b.

Remedy Description/Alternative	Peak Sr-90 Concentration in 2095, pCi/L	Date MCL is Attained	Comments
1	19	2129	RI/BRA base case
2a/2b	7.9	2095	Recharge reduced to < 1 mm/yr over PRCZ
2a/2b + OU 3-13 Group 4	6.0	2089	Includes benefits from the Group 4 perched water remedy (reducing anthropogenic water and lining the Big Lost River)

Groundwater RAO I would be met as long as institutional controls remain in place. Groundwater RAO II would met because concentrations of Sr-90 in SRPA groundwater are predicted to be below the MCL in 2095 and after.

Surface soil RAOs III and IV would be met by administrative controls through 2095 and by the soil covers and selective excavation and backfilling with clean soil inside the tank farm boundary after 2095.

Environmental risks would be reduced or eliminated by the soil covers. RAO V would be met by the ET soil-capillary barrier cover, which would inhibit or eliminate intrusion by plants, burrowing animals, and insects.

5.2.2.2 Compliance with ARARs and TBCs. Table 5-5 summarizes the evaluation of both Alternatives 2a and 2b for compliance with ARARs and TBCs. NESHAP (40 CFR 61.92) and emission monitoring and compliance reputations are action-specific ARARs that are applicable to the tank farm surface soil under this alternative. This is because barrier construction and soil excavation may produce radionuclide emissions, other than radon, to ambient air from a DOE facility. NESHAP establishes an effective dose equivalent of 10 mrem/year to the public for radionuclide emissions, other than radon, to ambient air from DOE facilities. NESHAP standards would be met during barrier construction using dust suppressants and engineering controls. Other Clean Air Act and Idaho air regulations would be met by evaluating emissions from remediation activities during remedial design and implementing controls as required to meet emission limits. Long-term compliance with the action-specific ARARs would also be achieved by continued surface soil isolation by the soil or pavement barriers to control radionuclide or other releases to ambient air.

Idaho hazardous waste determination requirements would be met by RCRA characterization as described in IDAPA 58.01.05.006 (40 CFR 262.11) for any wastes placed, stored, or sent to an off-Site facility. State of Idaho groundwater quality rules would be met, because Sr-90 concentrations in the SRPA would not exceed applicable State of Idaho groundwater quality standards in 2095 and after.

Table 5-5. Summary of applicable or relevant and appropriate requirements for Alternatives 2a and 2b.

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to remediation activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.92, "Standard"		A		Applies to soil removal and cap construction activities. Would be met, because emissions would be below allowable levels.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Applies to soil removal and cap construction activities. Would be met, because emissions would be below allowable levels.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			Applies to soil removal and cap construction activities. Would be met, because emissions would be below allowable levels.
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and 58.01.01.651	A			Applies to soil removal and cap construction activities. Would be met, because emissions would be below allowable levels.

Table 5-5. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Idaho Hazardous Waste Management Act				
"Hazardous Waste Determination," 40 CFR 262.11	A	A		Applies to incidental waste that may be generated during remediation activities that would be stored long term or treated. Would be met by appropriate characterization.
Idaho Ground Water Quality Rules				
"Ground Water Quality Rule," IDAPA 58.01.11	A			Would be met because Sr-90 concentrations in the SRPA would be below applicable State of Idaho groundwater quality standards in 2095 and after.
To-Be-Considered Requirements				
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to tank farm soil remediation. Would be met by design and construction to requirements identified in the remedial design.
"Radioactive Waste Management," DOE Order 435.1	TBC			Applies to radioactive waste generated from remediation activities. Would be met by disposal in ICDF or at an ICDF-equivalent on-Site or off-Site disposal facility.
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to tank farm soil during institutional control period, because contamination would remain in place after remediation above levels that allow for unrestricted use and access. Would be met by institutional control approach defined in RD/RA work plan.

Key:
A = applicable requirement.
TBC = to be considered.

5.2.2.3 Long-term Effectiveness and Permanence. Alternative 2a would provide a high degree of long-term effectiveness and permanence because the ET covers with native plant surface vegetation are designed to meet the requirements cited in Section 4 for at least 222 years with little or no maintenance after the end of institutional controls, based on observations by Anderson et al. (1987) and others that the native plant community on the INL Site can effectively remove soil moisture to a depth of about 1.5 m; and based on evidence that the INL Site has had a stable climax plant community for thousands of years. The ET soil cover, in combination with a gravel-cobble capillary barrier, would be expected to remain functional for the required durations, i.e., to reduce infiltration for at least 117 years and to reduce human direct exposure risks and risks to biota for 222 years. This barrier would likely remain functional beyond 222 years; however, only the required design life is evaluated for the purposes of this alternative. The cover provides a clean soil barrier to prevent direct exposure to Cs-137, reduce infiltration, resist erosion, and promote runoff. The ET covers and soil removal would protect future workers and ecological receptors for the duration of risk, even in the absence of institutional controls.

The ET soil-capillary barrier cover would extend beyond the estimated extent of soil contamination at the tank farm on all sides to ensure that contaminated soil is adequately covered. Side slopes steeper than 4h:1v would be rock-armored to prevent erosion. The gravel-cobble biobarrier would inhibit or eliminate exposures to ecological receptors or mobilization of contaminated soil by deeply rooting plants or burrowing animals.

As discussed in Section 3, the ET soil-capillary barrier cover can reduce infiltration rates to less than 1 mm/yr under average INL Site climatic conditions. The cover would be constructed primarily of natural rock and soil materials. Chemical and physical weathering of these materials would not result in significant deterioration during the 222-year functional design life. The native plant community established on the ET cover surface would be expected to remain dominant through the required design life of the cover. Palynological and archeological studies indicate that plant species composition on the Snake River Plain have remained very much the same during the Holocene (the past 10,000 years) (Davis and Bright 1983; Davis, Sheppard, and Robertson 1986; Steadman et al. 1994). The results of pollen cores collected from cave deposits on the INL Site and from surrounding areas were compiled and evaluated to gain a better understanding of the resources available to early hunters and their prey from the Late Pleistocene into historic times (Plager and Holmer 2005). This study also indicates that, although vegetation landscape changed in the surrounding area, the area of the INL Site was in sagebrush steppe since the early Holocene Extreme (9100-9500 BP). However, climate change, fire, or grazing could impair infiltration control performance of the ET cover by changing average annual precipitation patterns or by reducing the density of vegetation coverage. Most of these effects could be mitigated if they occurred during the institutional control period. The long-term effectiveness and permanence of the ET covers for protection of future workers and ecological receptors is considered high.

The clean soil fill in the north tank farm perimeter area would be covered with low-permeability paving. The clean soil fill would be completed at grade and would be expected to provide a 4-ft clean soil layer for at least 222 years. The paved surface over the north tank farm perimeter, CPP-58, and the PRCZ and the concrete pad over CPP-15 would require maintenance and periodic replacement to provide continued infiltration control.

Access restrictions would control groundwater use for the duration of institutional controls, through at least 2095. State of Idaho drinking water standards would be attained by 2095 and no further institutional controls would be required.

5.2.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment. Treatment would not be implemented with Alternative 1. Some reduction in contaminant mass and concentration would be indirectly achieved through natural radioactive decay of Cs-137 and Sr-90 and other natural attenuation processes, such as dispersion of Sr-90 in groundwater. The toxicity of contaminated materials would also be reduced by a decrease in radionuclide concentration through natural decay and dispersion. Over 200 years would be required for natural radioactive decay alone to reduce the Cs-137 95% upper confidence level concentrations in the 0 to 4-ft interval inside the tank farm boundary to the current worker exposure PRG of 11.3 pCi/g. Less than 80 years would be required to reach the PRG at CPP-15 and CPP-58.

5.2.2.5 Short-term Effectiveness. Risks to workers, outlying communities, and the environment during implementation of the remedies would be low or none. Soil removal would be performed in perimeter areas with relatively low concentrations of Cs-137 and other contaminants of concern. All gamma fields would be expected to be below 200 mR/hr. Personnel exposures would be controlled through ALARA to less than allowable levels. No significant additional risks to the public or workers would occur. The tank farm is not located near any residential population, and impacts to outlying communities would be negligible because of the continued access restrictions during the institutional control period that would eliminate the exposure risks. Most of the ET cover materials would come from sources on the INL Site; therefore, additional transportation risks on public roads would be very low.

Onsite workers could potentially be exposed to occupational injury or direct radiation during implementation. Administrative control and monitoring activities would be conducted by trained personnel in accordance with standard radiological engineering operational procedures, including ALARA review, HASPs, and safe work practices to maintain a work environment that minimizes injury or exposure risks. These procedures would ensure that onsite worker exposures would be maintained ALARA.

No additional ecological impacts are anticipated under this alternative. The tank farm sites are located at INTEC, an active operational facility at the INL Site. Site areas are already disturbed by construction and operational activities and do not support any unique or significant ecological resources. No environmentally sensitive archaeological or historical sites, wetlands, or critical habitat exist within the tank farm area.

5.2.2.6 Implementability. Excavation, backfilling, and paving on the north tank farm perimeter and paving of the north and south tank farm perimeters and the PRCZ can be implemented after 2012, when surface infrastructure has been removed. The remedial design would include regrading throughout the PRCZ to promote storm water drainage and additional lined drainage channels to convey water to the existing and potentially new lift stations and to the existing evaporation pond. Extensive regrading could be required throughout the PRCZ prior to asphalt paving to achieve positive drainage. New lined drainage ditches, sumps, and lift stations could be required.

Capping with an ET cover on the central tank farm by 2012 is less implementable. As discussed in Section 4, retaining walls would be required around Building CPP-659 and potentially Tank WM-191, Beech Street would be closed, and inactive Buildings CPP-654 and -699 would have to be removed.

Conventional earthwork and asphalt paving construction methods would be used to construct the ET soil-capillary barrier and low-permeability asphalt covers, respectively. In terms of complexity and expertise required, surface barrier construction is similar to other types of civil engineering earth work such as highway construction. The constructability of the ET soil-capillary barrier and low-permeability asphalt covers is considered high.

Excavated soil would be characterized at the INTEC Remote Analytical Laboratory to meet ICDF Waste Acceptance Criteria (WAC) requirements. It is assumed for cost estimating purposes that the Remote Analytical Laboratory would be available for the duration of excavation and disposal.

The ET covers would require minimal maintenance and repairs. Only the surface of the barrier is accessible to damage. The surface layer is easily repaired by replacing eroded or excavated soil material with similar material. Low-permeability asphalt covers would require more maintenance and repair to remain effective, as discussed previously.

Implementation is administratively feasible, because surface barriers as remedial alternatives do not represent any unique or unusual requirements for regulatory approval, concurrence, or variance actions. A framework has been negotiated between the EPA, DEQ, and DOE for developing, prioritizing, implementing, and monitoring environmental restoration activities (DOE-ID 1991). Administrative issues at CERCLA sites are primarily resolved through this agreement.

No specialized equipment, personnel, or services are required to implement this alternative. Barrier construction would not require any specialized construction equipment or personnel with unique skills or education. Personnel with specialized skills would be required for some excavation activities where proximity to operational facilities or utility lines could require significant shoring, bracing, or temporary structural support. Health and safety professionals would be required to perform personnel monitoring. These personnel and others required for implementation of this alternative are readily available at the INL Site. Technologies required to implement this alternative are also readily available and use standard equipment. No additional development of these technologies would be required. In general, standard construction practices would be used to implement this alternative, and a sufficient number of local contractors possessing the required skills and experience are available.

No specific issues are anticipated in seeking or obtaining competitive bids from contractors to do this work. Sufficient borrow materials for barrier construction are available at the Ryegrass Flats soil borrow site and INL Site gravel borrow pits. No significant technical problems, schedule delays, or cost overruns would be anticipated.

Overall technical implementability of Alternative 2a is considered low due to the extensive additional work required to eliminate and replace or to protect existing infrastructure that will remain active after 2012.

5.2.2.7 Cost. Capital, O&M, and periodic costs for Alternative 2a through 2095 are provided as NPV in Table 5-6. Costs for infrastructure modifications discussed in Section 4 are included. The base year used in calculating NPV is 2006, with remedy implementation assumed to begin in 2012. OU 3-13 Group 5 groundwater monitoring costs as identified in the current life-cycle baseline are included, because this monitoring would become part of the OU 3-14 SRPA remedy through the OU 3-14 ROD.

Table 5-6. NPV of Alternative 2a through 2095.

Cost Element	NPV (million)
Capital cost	$6.89
O&M cost	2.66
Periodic cost	2.68
Total through 2095	12.2

5.2.3 Alternative 2b—Institutional Controls, Monitoring, Excavation and Containment by 2035

Alternative 2b is identical to Alternative 2a, with the exception that the final ET cover over the central tank farm would not be constructed until 2035. A low-permeability asphalt pavement cap would be constructed to provide infiltration control until the final ET cover was constructed before 2035. Only the differences arising from phased cover construction are discussed below.

5.2.3.1 Overall Protection of Human Health and the Environment. Overall protection of human health and the environment for Alternative 2b would be the same as for Alternative 2a, as discussed in Section 5.2.2.1.

5.2.3.2 Compliance with ARARs and TBCs. Compliance with ARARs and TBCs for Alternative 2b would be the same as for Alternative 2a, as identified in Table 5-5 and as discussed in Section 5.2.2.2.

5.2.3.3 Long-term Effectiveness and Permanence. Long-term effectiveness and permanence for Alternative 2b would be the same as for Alternative 2a, as discussed in Section 5.2.2.3.

5.2.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment. Reduction of toxicity, mobility, and volume for Alternative 2b would be the same as for Alternative 2a, as discussed in Section 5.2.3.4.

5.2.3.5 Short-term Effectiveness. Short-term effectiveness for Alternative 2b would be essentially the same as for Alternative 2a, as described in Section 5.2.2.5. Construction of a low-permeability asphalt cover as part of phased remedy implementation would not increase risks to workers, the public, or the environment.

5.2.3.6 Implementability. Alternative 2b was formulated specifically to address implementability concerns with Alternative 2a. Alternative 2b would occur in phases, with construction of a final ET cover on the central tank farm at the estimated end of INTEC operations in 2035. Construction of a low-permeability asphalt cover by 2012, followed by subsequent capping with an ET cover by 2035, would require additional paving work relative to Alternative 2a.

Paving with low-permeability asphalt before 2012 could be relatively easily implemented and maintained, even if surface infrastructure in the central tank farm was not leveled to grade, or continued INTEC operations did not allow for complete implementation of the final remedy. If Tanks WM-180 through WM-190 were not grouted, MatCon asphalt would not be used, and standard asphalt applied with lighter equipment and seal-coated could be used instead. Asphalt with seal-coating previously applied in the central tank farm as part of the TFIA could be maintained and additional area covered. The low-permeability asphalt cover on the central tank farm could be left in place at the time of final ET soil-capillary barrier construction or could be removed. Extensive regrading would not be required.

The ramp north of CPP-604 would be regraded and underlying infrastructure removed prior to constructing the ET cover as a continuous unit over the central tank farm and south perimeter. A cut-and-fill plan would be prepared during RD to minimize the amount of excess soil for disposal at the ICDF while achieving the final grades required for drainage. Buildings CPP-604 and CPP-659 and Tank WM-191 would be out of service and have undergone decontamination and decommissioning (D&D) to the concrete building foundations or to grade prior to capping. No modifications are assumed to be required to build the ET cap over or around the building remnants. The southeast drainage channel covered by the cap would be replaced.

Conventional asphalt paving and construction methods would be used to construct the initial low-permeability asphalt cover and the final ET cover, respectively. In terms of complexity and expertise required, surface barrier construction is similar to other types of civil engineering earth work such as highway construction. The constructability of the low-permeability asphalt cover and the ET soil-capillary barrier is considered high.

5.2.3.7 Cost. Capital, O&M, and periodic costs for Alternative 2b through 2095 are provided as NPV in Table 5-7. The base year used in calculating NPV is 2006, with remedy implementation assumed to begin in 2012. OU 3-13, Group 5, groundwater monitoring costs as identified in the current life-cycle baseline are included, because this monitoring would become part of the OU 3-14 SRPA remedy through the OU 3-14 ROD.

Table 5-7. NPV of Alternative 2b through 2095.

Cost Element	NPV (million)
Capital cost	$3.70
O&M cost	2.66
Periodic cost	2.68
Total through 2095	9.04

5.2.4 Alternatives 3a and 3b—Source Removal and Containment by 2012 and 2035, Respectively

Alternatives 3a and 3b are identical to Alternatives 2a and 2b, respectively, except for the addition of soil removal at CPP-31 in 2012 and 2035, respectively. Only the differences due to soil removal at CPP-31 are discussed below.

5.2.4.1 Overall Protection of Human Health and the Environment. RAOs I-V would be met by maintaining institutional controls, capping CPP-58 and the PRCZ with low-permeability asphalt, maintaining the concrete transformer pad at CPP-15 as part of the capped area, selective excavation and backfilling with clean soil prior to paving with low-permeability asphalt at the north tank farm perimeter, and constructing an ET cover over the central and south tank farm. Excavation of CPP-31 would provide no added protection to the future worker beyond that provided by the ET soil cover. Implementing the alternative in 2012 vs. 2035 would have no significant effect on overall protection of human health and the environment.

Removing residual Sr-90 at CPP-31 would provide only a very minor reduction in the SRPA concentration in 2095. Table 5-8 summarizes groundwater modeling results reported in Appendix A for Alternatives 3a and 3b. Removing residual Sr-90 at CPP-31 alone resulted in a decrease in the 2095 concentration from 18.6 to 16.9 pCi/L, a difference of 1.7 pCi/L, with no other remedies in place. Potential OU 3-13 Group 4 remedies including lining the Big Lost River and reducing anthropogenic water by 50% resulted in a 2095 concentration of 13.5 pCi/L, and attainment of the MCL in 2115. When removing residual Sr-90 at CPP-31 was added to the potential OU 3-13 Group 4 remedies, the result was a concentration of 12.5 pCi/L in 2095, attainment of the MCL in 2110, a decrease of 1 pCi/L in the 2095

Table 5-8. Groundwater modeling results for Alternatives 3a/3b and 4a/4b.

Remedy Description/Alternative	Peak Sr-90 Concentration in 2095, pCi/L	Date MCL is Attained	Comments
1	18.6	2129	Model results-RI/BRA base case results
Remove or immobilize residual Sr-90 at CPP-31	16.9	2122	Model results
3a/3b or 4a/4b	6.9	2090	Extrapolated from model results as described in text
3a/3b or 4a/4b + potential OU 3-13 Group 4 remedies	5.0	2084	Extrapolated from model results as described in text

concentration, and attainment of the MCL 5 years sooner. The Alternatives 3a and 3b combination of capping plus removing residual Sr-90 at CPP-31, combined with potential OU 3-13 Group 4 remedies, was not modeled but would not be expected to reduce the 2095 SRPA concentration by more than 1 pCi/L nor reduce the time to attainment of MCLs by more than 5 years, relative to capping plus potential OU 3-13 Group 4 remedies.

The effects of removing residual Sr-90 at CPP-31 in 2035 as for Alternative 3b, versus in 2012 as for Alternative 3a, were not modeled but would not be expected to be significant. Reducing infiltration has a much greater effect on reducing Sr-90 flux to the SRPA than does removing residual Sr-90 from alluvium, based on modeling results reported in Appendix A. An infiltration-reducing cap would be implemented in 2012 for both alternatives, resulting in little or no difference in attainment of the MCL.

5.2.4.2 Compliance with ARARs and TBCs. Table 5-9 summarizes the evaluation of both Alternatives 3a and 3b for compliance with ARARs and TBCs. Compliance with ARARs and TBCs for Alternative 3b would be the same as for Alternative 3a. The effects of removing residual Sr-90 at CPP-31 in 2035 as for Alternative 3b, versus in 2012 as for Alternative 3a, were not modeled but would not be expected to be significant. Reducing infiltration would have a much greater effect on reducing Sr-90 flux to the SRPA than would removing residual Sr-90 from alluvium, based on modeling results reported in Appendix A. An infiltration-reducing cap would be implemented in 2012 for both alternatives, resulting in little or no difference in attainment of the MCL.

Clean Air Act and Idaho air rules, including NESHAP standards, would be met by evaluating potential releases during remedial design and incorporating adequate engineering controls to meet all requirements. The RA work plan would implement administrative controls, including emission monitoring and reporting, to meet requirements, based on the RD evaluation. Long-term compliance with action-specific ARARs would also be achieved by continued surface soil isolation by the mass of soil or pavements composing the barriers to control radionuclide or other releases to ambient air.

Idaho hazardous waste determination requirements would be met by RCRA characterization as described in IDAPA 58.01.05.006 (40 CFR 262.11) for any wastes placed, stored, or sent to an off-Site facility, as could occur under Alternative 3b, because CPP-31 soil would be excavated and disposed of after the planned closure date for ICDF in 2013, requiring an alternate disposal facility. Placement, storage, or off-Site shipment would not occur under Alternative 3a. RCRA Hazardous Waste Determination rules under 40 CFR 262.11 would be met for incidental secondary wastes generated during Alternative 3a or 3b that were stored or treated by characterizing the wastes according to RCRA requirements and the disposal facility WAC.

5.2.4.3 Long-term Effectiveness and Permanence. Removal of Site CPP-31 would provide a high degree of long-term effectiveness and permanence, because residual contamination would be removed for disposal in an engineered containment facility. The ICDF or an ICDF-equivalent on-Site or off-Site disposal facility would effectively contain the Sr-90 until radioactive decay eliminated risks to the SRPA. However, the Sr-90 MCL in the SRPA would still be exceeded after 2095 due to continued flux from the perched water and vadose zone under the alluvial soil. Long-term effectiveness and permanence for Alternative 3b would be the same as for Alternative 3a.

5.2.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment. Removal of Site CPP-31 as part of Alternative 3a or 3b would provide no treatment. Treatment would not be required for disposal at the ICDF and is, therefore, not considered. Radioactive decay, however, would reduce toxicity and volume of Sr-90 over time.

5.2.4.5 Short-term Effectiveness. No risks to the public or the environment would result from removal of CPP-31 soil. Excavation would be performed in an enclosure with controls on air emissions. Worker exposures would exceed allowable levels, if not controlled, since direct gamma exposure rates of over 20 R/hr would be encountered; however, exposures would be reduced to allowable levels through administrative controls and by using remotely operated equipment and conventional equipment with shielding, with a resulting increase in numbers of workers and overall project complexity. Even if all worker exposures were controlled to facility limits, the total occupational exposures for Alternatives 3a and 3b, calculated as total person-rem, would be higher than for any other alternative. Potential worker exposures for Alternative 3b would be lower than for Alternative 3a, since an additional 23 years of radioactive decay would significantly reduce Cs-137 soil concentrations and thereby gamma radiation exposure levels.

5.2.4.6 Implementability. Implementability of removal of Site CPP-31 is relatively low due to the requirement for remote retrieval of about 50% of the soil present, the depth of removal required, the presence of subsurface infrastructure, and continued INTEC operations. Equipment capable of remote soil retrieval is commercially available but from few vendors. Conventional equipment is available at the INL Site or commercially. The required depth of excavation of up to 60 ft bgs would dictate use of access ramps and extensive shoring and would increase the complexity of this alternative.

Only inactive infrastructure would remain in the tank farm by 2035, which would improve the technical implementability of CPP-31 soil removal for Alternative 3b. However, the ICDF would not be available in 2035, which would greatly reduce the technical and administrative feasibility of soil disposal and, thereby, the overall implementability of Alternative 3b.

Table 5-9. Compliance with ARARs and TBCs for Alternatives 3a and 3b.

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to remediation activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
40 CFR 61.92, "Standard"		A		This standard limits annual emissions of radionuclides to the ambient air to any member of the public to an effective dose equivalent of 10 mrem/yr. The standard would be met by administrative and engineering controls.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			The standard would be met by engineering and administrative controls implemented through the RD/RA work plan.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			The standard would be met by engineering and administrative controls implemented through the RD/RA work plan.
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and .651	A			The standard would be met by engineering and administrative controls implemented through the RD/RA work plan.
Idaho Hazardous Waste Rules				
"Hazardous Waste Determination" IDAPA 58.01.05.006 (40 CFR 262.11)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal. Would be met by characterization required by facility WAC.

Table 5-9. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
"Temporary Units" IDAPA 58.01.05.008 (40 CFR 264.553)	A			Applies to temporary treatment units located within operable unit. Standards and substantive permit requirements would be met by RD/RA work plan.
"Land Disposal Requirements" IDAPA 58.01.05.011 (40 CFR 268)	A			Applies to OU 3-14 wastes that have been placed, stored, or are being sent to an off-Site facility for treatment or disposal. Would be met by characterization and treatment if required.
"Alternative LDR Treatment Standards for Contaminated Soil" IDAPA 58.01.05.011 (40 CFR 268.49)	A			Applies to OU 3-14 soil that has been placed, stored, or sent to an off-Site facility for treatment or disposal. Would be met by characterization and treatment if required.
To-Be-Considered Requirements				
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to tank farm soil remediation. Substantive design and construction requirements will be met to keep public radiation exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE Order 435.1	TBC			Applies to radioactive waste generated from the investigation and remediation activities. Would be met by disposal in an approved facility.
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to tank farm soil during institutional control period, if contamination remains in place after remediation above levels that allow for unrestricted use and access. Would be met by the institutional control approach defined in the RD/RA work plan.

Key:
A = applicable requirement.
TBC = to be considered.

5.2.4.7 Cost. Capital, O&M, and periodic costs for Alternatives 3a and 3b through 2095 are provided as NPV in Table 5-10. The base year used in calculating NPV is 2006, with remedy implementation assumed to begin in 2012. OU 3-13 Group 5 groundwater monitoring costs as identified in the current life-cycle baseline are included, because this monitoring would become part of the OU 3-14 SRPA remedy through the OU 3-14 ROD.

Table 5-10. NPV of Alternatives 3a and 3b through 2095.

Cost Element	NPV of Alternative 3a (million)	NPV of Alternative 3b (million)
Capital cost	$37.8	$22.2
O&M cost	2.66	2.66
Periodic cost	2.68	2.68
Total through 2095	43.1	27.5

5.2.5 Alternatives 4a and 4b—Institutional Controls, Monitoring, In Situ Soil Treatment, Containment, and Contingent Snake River Plain Aquifer Pump and Treat

Alternatives 4a and 4b are identical to Alternatives 2a and 2b, respectively, except for the addition of in situ grouting at CPP-31. Only the differences due to in situ grouting at CPP-31 are discussed below.

5.2.5.1 Overall Protection of Human Health and the Environment. RAOs I-V would be met by maintaining institutional controls, capping CPP-58 and the PRCZ with low-permeability asphalt, maintaining the concrete transformer pad at CPP-15 as part of the capped area, selective excavation and backfilling with clean soil prior to paving with low-permeability asphalt at the north tank farm perimeter, and constructing an ET cover over the central and south tank farm. Immobilizing residual Sr-90 in soil at CPP-31 would provide no added protection to the future worker beyond that provided by the ET soil cover.

Removing or immobilizing residual Sr-90 at CPP-31 would provide only a very minor reduction in the SRPA concentration in 2095, as discussed previously in Section 5.2.4.1 for Alternatives 3a and 3b. Table 5-8 summarizes groundwater modeling results reported in Appendix A. The Alternatives 4a and 4b combination of capping plus immobilizing residual Sr-90 at CPP-31, combined with potential OU 3-13 Group 4 remedies, was not modeled but would not be expected to reduce the 2095 SRPA concentration by more than 1 pCi/L nor reduce the time to attainment of MCLs by more than 5 years, relative to capping plus potential OU 3-13 Group 4 remedies. Implementation in 2012 vs. 2035 would have no significant effect on overall protection of human health and the environment.

The effects of immobilizing residual Sr-90 at CPP-31 in 2035 as for Alternative 4b, versus in 2012 as for Alternative 4a, were not modeled but would not be expected to be significant. Reducing infiltration has a much greater effect on reducing Sr-90 flux to the SRPA than does immobilizing residual Sr-90 in the alluvium, based on modeling results reported in Appendix A. An infiltration-reducing cap would be implemented in 2012 for both alternatives, resulting in little or no difference in attainment of the MCL.

In situ grouting of CPP-31 would immobilize a significant fraction of the Sr-90 remaining at OU 3-14; however, all of the contaminated soil could not be contacted. Based on the in situ grouting site plan shown in Section 4, about 203 or 55% of the 516 boreholes shown on the preliminary layout could be completed without encountering surface or subsurface infrastructure. Moving borehole locations slightly or using angle drilling could potentially increase the effectiveness of borehole completion; however, 70% is regarded as the likely maximum completion number. The overall effectiveness of immobilizing residual Sr-90 in alluvial soil at CPP-31 could be higher or lower than the effectiveness of borehole completion, because contamination is not uniformly distributed within the treatment area.

The effectiveness of several grout types and grout-soil mixtures for attenuating Sr-90 would be determined in bench- and pilot-scale testing during remedial design. Based on previous studies reported in Section 3, cement-based grouts strongly immobilize strontium in the calcium silicate matrix.

5.2.5.2 Compliance with ARARs and TBCs. Compliance with ARARs and TBCs for Alternatives 4a and 4b is the same as for Alternatives 3a and 3b, as identified in Table 5-9 and as described in Section 5.2.2.2. In situ grouting of CPP-31 and disposal of grout returns and other secondary waste would not result in any additional requirements. The effects of immobilizing residual Sr-90 at CPP-31 in 2035 as for Alternative 4b, versus in 2012 as for Alternative 4a, on attainment of the MCL were not modeled but would not be expected to be significant. Reducing infiltration has a much greater effect on reducing Sr-90 flux to the SRPA than does immobilizing residual Sr-90 in the alluvium, based on modeling results reported in Appendix A. An infiltration-reducing cap would be implemented in 2012 for both alternatives, resulting in little or no difference in attainment of the MCL.

5.2.5.3 Long-term Effectiveness and Permanence. In situ grouting of Site CPP-31 would provide a high degree of long-term effectiveness and permanence because residual contamination would be immobilized in place in a durable waste form resistant to leaching of Sr-90. However, some degradation would occur over time due to physical and chemical processes discussed in Section 3. Based on modeling performed for the *Performance Assessment for the Tank Farm Facility at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 2002), grouted waste would be expected to retain Sr-90 for at least 300 years, after which less than 0.1% of the mass of Sr-90 initially present would remain due to radioactive decay. Long-term effectiveness and permanence for Alternative 4a would be the same as for Alternative 4b.

5.2.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment. In situ grouting would be used to contact as much of the strontium-contaminated soil at CPP-31 as is technically feasible, estimated at about 70% of the total soil volume of 17,625 yd^3. The estimated contact efficiency could be greater or less, depending on the contact radius achievable by each borehole, which would be determined in field testing. Total curies of Sr-90 potentially remaining in this volume of soil are estimated in the OU 3-14 RI/BRA Appendix A. Grout returns for disposal at the ICDF were estimated in Section 4 at 10% of the total soil volume treated or about 1,800 yd^3.

Reduction of toxicity, mobility, and volume through treatment would be somewhat greater for Alternative 4a than for Alternative 4b. More Sr-90 would be present in soil and, thereby, available for treatment in 2012 than in 2035, due to radioactive decay.

5.2.5.5 Short-term Effectiveness. Potential occupational injury or external radiation exposure risks would exist for onsite workers during in situ grouting of CPP-31. In situ grouting uses high-pressure fluids. However, jet grouting has been performed in both treatability studies and in remedial actions at the INL Site, and lessons learned during those projects would be applied at OU 3-14. Use of a thrust block, as discussed in Section 4, to contain grout returns, as well as standard radiological controls, would ensure that onsite worker exposures would be maintained ALARA and, in addition, that no risks to the public or the environment would result from implementation of the remedy. The short-term effectiveness of other components of Alternatives 4a and 4b, including institutional controls, monitoring, soil excavation, and capping, is as described for Alternatives 2a and 2b.

5.2.5.6 Implementability. In situ grouting of CPP-31 is technically and administratively implementable. In situ grouting has been demonstrated at pilot- and full-scale on the INL Site as discussed in Sections 3 and 4. Vendors are available with experience in performing in situ jet grouting at DOE sites.

The ICDF would be available to accept grout returns produced by Alternative 4a but not Alternative 4b. The most significant technical challenge would be completing a sufficient number of boreholes in the tank farm, where extensive subsurface infrastructure will remain after completion of the tank closures.

Monitoring the effectiveness of the remedy would be difficult or impossible without coring or excavating the grouted soil. Geophysical methods to determine distribution of grout were not identified. Cold tests outside the tank farm may not simulate the grout distribution achievable in the presence of tank farm infrastructure, where voids, heterogeneous soil densities, and subsurface structures could direct grout flow unevenly.

Only inactive infrastructure would remain in the tank farm by 2035, which would improve implementability of Alternative 4b. However, the ICDF would not be available for disposal of grout returns.

5.2.5.7 Cost. Capital, O&M, and periodic costs for Alternatives 4a and 4b through 2095 are provided as NPV in Table 5-11. The base year used in calculating NPV is 2006, with remedy implementation assumed to begin in 2012. OU 3-13 Group 5 groundwater monitoring costs, as identified in the current life-cycle baseline, are included, because this monitoring would become part of the OU 3-14 SRPA remedy through the OU 3-14 ROD.

Table 5-11. NPV of Alternatives 4a and 4b through 2095.

Cost Element	NPV for Alternative 4a (million)	NPV for Alternative 4b (million)
Capital cost	$10.8	$5.99
O&M cost	2.66	2.66
Periodic cost	2.68	2.68
Total through 2095	16.1	11.3

5.2.6 Alternative 5—Contingent Snake River Plain Aquifer Pump and Treat

Alternative 5 provides for the contingency that groundwater pumping and treatment may be required to meet RAO II. Alternative 5 is presented as a separate alternative; however, it would only be implemented after an OU 3-14 alternative, including groundwater monitoring, and OU 3-13 Group 4 remedies had been implemented and determined to not meet RAO II.

5.2.6.1 Overall Protection of Human Health and the Environment. Alternative 5 is assessed only with respect to RAO II. Table 5-12 summarizes modeling results reported in Appendix A. Alternative 5 would meet RAO II if pumping was maintained through the period 2077 through 2123.

Table 5-12. Modeling results for Alternative 5.

Remedy Description/Alternative	Peak Sr-90 Concentration in 2095, pCi/L	Date MCL is Attained[a]	Comments
1	18.6	2129	RI/BRA base case results
5	8.0	2123	Alternative 5 only, no other OU 3-13 Group 4 or OU 3-14 remedies included.

a. "Date MCL is attained" is date when pumping can end without rebound in concentrations.

5.2.6.2 Compliance with ARARs and TBCs. Compliance with ARARs and TBCs for Alternative 5 is summarized in Table 5-13. State of Idaho groundwater quality rules would be met for the area of the SRPA affected by INTEC releases in 2095 and after. State of Idaho well construction rules would be met for new pumping and monitoring wells by requirements identified and incorporated in the remedial design. Clean Air Act and Idaho air regulations would be met by assessing emissions prior to constructing and operating the pump and treat system and mitigating emissions above allowable levels.

5.2.6.3 Long-term Effectiveness and Permanence. The long-term effectiveness of pumping and treating the SRPA would depend on the duration of pumping. If pumping continued until at least 2123, this alternative could be completely effective. If pumping stopped before that time, concentrations of Sr-90 in the SRPA beneath INTEC could rebound above the MCL due to continued flux from the vadose zone. Even under BRA base case conditions, however, concentrations outside the INTEC fenceline are not predicted to exceed the MCL after 2095.

5.2.6.4 Reduction of Toxicity, Mobility, or Volume through Treatment. Relatively minor amounts of Sr-90, i.e., less than 0.1 Ci, would be removed annually from the SRPA under this alternative, compared to an estimated 12,336 curies of Sr-90 predicted to have left the alluvium. Residuals generated by the treatment process include treated groundwater, regenerant, and spent ion exchange resins. As discussed in Section 4, treated groundwater would be reinjected, regenerant solutions would be discharged to new evaporation ponds, and spent ion exchange resins would be disposed of at an ICDF-equivalent facility. Total annual quantities of each are listed in Table 5-14.

Pumping of the SRPA to clean it up would reduce the areal extent of the Sr-90 plume originating from the tank farm and would, therefore, effectively reduce the mobility and volume of Sr-90 for the duration of pumping. If pumping continued until 2123, the reductions would be permanent and concentrations would remain below MCLs.

5.2.6.5 Short-term Effectiveness. The pump and treat cleanup system can be constructed and operated with little or no additional risks to the public, workers, or the environment. The treatment plant and regenerant evaporation pond would not be constructed in areas of known contamination. Exposure of workers to contaminants would be minimized by use of appropriate personal protective equipment, use of engineering controls, and following the HASP.

The water treatment system would use ion-exchange resins. This type of treatment plant would not produce significant atmospheric releases and, therefore, would produce no risks to workers, the public, or the environment. The masses of contaminants concentrated in the ion-exchange resins would produce exposure levels far below limits that would require shielding or remote handling to reduce risk to workers.

Table 5-13. Compliance with ARARs and TBCs for Alternative 5.

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Clean Air Act and Idaho Air Regulations				
"Toxic Substances," IDAPA 58.01.01.161 "Toxic Air Pollutants, Noncarcinogenic Increments," IDAPA 58.01.01.585 "Toxic Air Pollutants, Carcinogenic Increments," IDAPA 58.01.01.586 "Environmental Remediation Source," IDAPA 58.01.01.210.16(a)		A		Applies to remediation activities. Compliance with IDAPA 58.01.01.161 requires that the release of noncarcinogenic and carcinogenic contaminants into the air must be estimated in accordance with IDAPA 58.01.01.210 before start of construction, controlled, if necessary, and monitored. If these increments cannot be met for remediation sources, compliance with IDAPA 58.01.01.161 will be met in accordance with IDAPA 58.01.01.210.16(a), "Environmental Remediation Source."
"Ambient Air Quality Standards For Specific Air Pollutants," IDAPA 58.01.01.577		A		The remediation activities will comply with the applicable emission standards and will not cause or significantly contribute to a violation of an ambient air quality standard. Modeling will be performed if deemed necessary.
40 CFR 61.92, "Standard"		A		Air emissions will be assessed during RD and mitigated as required using engineering and administrative controls.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.92, "Standard"		A		Air emissions will be assessed during RD and mitigated as required using engineering and administrative controls.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.93, "Emission Monitoring and Test Procedures"	A			Monitoring requirements will be determined during RD and implemented through the RD/RA work plan.
"National Emission Standards for Hazardous Air Pollutants," 40 CFR 61.94(a), "Compliance and Reporting"	A			Compliance and reporting requirements will be determined during RD and implemented through the RD/RA work plan.
"Rules for Control of Fugitive Dust," and "General Rules," IDAPA 58.01.01.650 and .651	A			Air emissions will be assessed during RD and mitigated as required using engineering and administrative controls.

Table 5-13. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
Idaho Department of Water Resources Rules				
"Well Construction Standards Rules," IDAPA 37.03.09	A			Standards will be met by implementing technical requirements through the RD/RA work plan.
"Rules and Minimum Standards for the Construction and Use of Injection Wells in the State of Idaho," IDAPA 37.03.03	A			Standards will be met by implementing technical requirements through the RD/RA work plan.
Idaho Hazardous Waste Rules				
"Hazardous Waste Determination" IDAPA 58.01.05.006 (40 CFR 262.11)	A			Applies to OU 3-14 wastes generated during pump and treat remediation activities that are placed, stored, or sent to an off-Site facility for treatment or disposal. Will be met by appropriate characterization prior to disposal.
"Hazardous Waste Determination," 40 CFR 262.11	A	A		Applies to wastes that are generated during pump and treat remediation activities and will be stored long term or treated. Will be met by appropriate characterization prior to disposal.
Idaho Ground Water Quality Rules				
"Groundwater Quality Rule," IDAPA 58.01.11	A			The groundwater extraction system will be designed to meet the applicable State of Idaho groundwater quality standards by 2095 and thereafter.
To-Be-Considered Requirements				
"Radiation Protection of the Public and the Environment," DOE Order 5400.5, Chapter II(1)(a,b)	TBC			Applies to groundwater sampling activities. Substantive design and construction requirements will be met to keep public radiation exposures as low as reasonably achievable.
"Radioactive Waste Management," DOE Order 435.1	TBC			Applies to radioactive waste generated from the investigation and remediation activities. Will be met by disposal of secondary wastes in an approved facility.

Table 5-13. (continued).

Requirement (Citation)	ARAR Type: Action Specific	ARAR Type: Chemical Specific	ARAR Type: Location Specific	Comments
EPA Region 10 Final Policy on Institutional Controls at Federal Facilities	TBC			Applies to that portion of the SRPA that exceeds applicable State of Idaho groundwater quality until concentrations drop below levels that allow for unrestricted use and access. Would be met by institutional control approach described in RD/RA work plan.

Key:
A = applicable requirement.
TBC = to be considered.

Table 5-14. Estimated quantities of groundwater treated, contaminants removed, and residuals generated for Snake River Plain Aquifer pump and treat.

Parameter	Annual Quantity
Sr-90 removed in treated groundwater, curies	4.4E-02
Groundwater treated and sent to injection well, gal	2.9E+08
Regenerant for disposal, lb	2.7E+06
Spent ion exchange resins for disposal, lb	7.1E+02

Remedial construction and O&M activities would be conducted by trained personnel in accordance with standard radiological engineering operational procedures, HASPs, and safe work practices to maintain a work environment that minimizes injury or exposure risks. These procedures would ensure that onsite worker exposures would be ALARA. Exposure of workers to contaminants would be minimized by use of appropriate personal protective equipment, use of engineering controls, and following the HASP.

5.2.6.6 Implementability. Constructing the SRPA pump and treat cleanup system would be technically implementable. The pump and treat system would operate from about 2077 through 2123. Operation beyond 2095 is assumed to be administratively feasible as part of continued implementation of an active ongoing remedy. Disposal capacity for solid secondary wastes, including spent resins and filters, will not be available at ICDF since the facility will be closed before Alternative 5 begins, based on current planning. However, as stated in Section 1, the ICDF was used as a disposal location for cost estimating purposes.

5.2.6.7 Cost. Capital, O&M, and periodic costs for Alternative 5 through 2095 are provided as NPV in Table 5-15. The base year used in calculating NPV is 2006, with remedy implementation assumed to begin in 2077. OU 3-13, Group 5, groundwater monitoring costs as identified in the current life-cycle baseline are included, because this monitoring would become part of the OU 3-14 SRPA remedy through the OU 3-14 ROD.

Table 5-15. NPV of Alternative 5 through 2095.

Cost Element	NPV for Alternative 5 (million)
Capital cost	$0.572
O&M cost	0.846
Periodic cost	0
Total through 2095	1.42

5.3 References

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6. COMPARATIVE ANALYSIS

The Operable Unit (OU) 3-14 remedial action alternatives, which are developed in Section 4 and analyzed in detail in Section 5, are compared in this section. The comparative analysis identifies the relative advantages and disadvantages of each alternative, so that the key tradeoffs that risk managers (EPA, DEQ, and DOE Idaho) must balance can be identified. The comparative analysis provides a measure of the relative performance of the alternatives against each evaluation criterion.

Alternatives are compared based on two of the three CERCLA categories, including threshold criteria and primary balancing criteria. The third category, modifying criteria, including state and community acceptance, will not be addressed until the Proposed Plan has been issued for public review. These modifying criteria will be addressed in the responsiveness summary and the Record of Decision (ROD), which will be prepared following the public comment period.

Sections 6.1 and 6.2 present the remedial alternative comparisons relative to each evaluation criterion. Table 6-1 summarizes how each tank farm alternative satisfies the remedial action objectives (RAOs) identified in Section 2. Table 6-2 summarizes the relative performance of each tank farm alternative for each evaluation criterion.

6.1 Threshold Criteria

Threshold criteria are of greatest importance in the comparative analysis, because they reflect the key statutory mandates of CERCLA, as amended. The threshold criteria that any viable alternative must meet are as follows:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements (ARARs) and other information to be considered (TBCs).

OU 3-14 remedial alternatives are compared with respect to the threshold criteria below.

6.1.1 Overall Protection of Human Health and the Environment

The primary measure of this criterion is the ability of an alternative to attain RAOs for the OU 3-14 soil and Snake River Plain Aquifer (SRPA). Alternatives are compared in Table 6-1 with respect to attainment of RAOs and are discussed below. A summary discussion is provided in Table 6-2.

All alternatives except Alternative 5 would meet RAO I by implementing institutional controls, including access restrictions through at least 2095. All alternatives except Alternative 5 meet RAO I equally well, because institutional controls are completely protective anywhere on the INL Site. However, Alternative 5 would only be implemented after Alternative 2a, 2b, 3a, 3b, 4a, or 4b had already been implemented and had been determined through SRPA monitoring to not be sufficiently protective of the aquifer. Alternative 5, in combination with Alternative 2a, 2b, 3a, 3b, 4a, or 4b, would meet all RAOs.

The predicted maximum concentrations of Sr-90 in 2095, and the predicted date the maximum contaminant level (MCL) would be attained for OU 3-14 alternatives are shown in Figures 6-1 and 6-2, respectively. Alternatives 2a, 2b, 3a, 3b, 4a, and 4b would meet RAO II by combining institutional controls with capping to reduce recharge in the primary recharge control zone (PRCZ) to below MCLs everywhere in the SRPA by 2095. Implementing potential OU 3-13 Group 4 remedies would further improve attainment of the MCL, as discussed in Section 5 and as shown in Figures 6-1 and 6-2. Alternative 5 would meet RAO II by removing Sr-90 from SRPA groundwater, beginning in 2077, to attain the MCL everywhere in the SRPA affected by INTEC releases by 2095.

Table 6-1. Comparison of OU 3-14 alternatives with respect to RAOs for OU 3-14 soil and the Snake River Plain Aquifer.

Alternatives	RAO I[a]	RAO II[a]	RAO III[a]	RAO IV[a]	RAO V[a]
Alternative 1	Meets the RAO	Does not meet the RAO	Meets the RAO for current workers; does not meet the RAO for future workers if institutional controls end	Meets the RAO	Does not meet the RAO
Alternative 2a	Meets the RAO	Meets the RAO	Meets the RAO for current and future workers	Meets the RAO	Meets the RAO
Alternative 2b	Meets the RAO	Meets the RAO	Meets the RAO for current and future workers	Meets the RAO	Meets the RAO
Alternative 3a	Meets the RAO	Meets the RAO	Meets the RAO for current and future workers	Meets the RAO	Meets the RAO
Alternative 3b	Meets the RAO	Meets the RAO	Meets the RAO for current and future workers	Meets the RAO	Meets the RAO
Alternative 4a	Meets the RAO	Meets the RAO	Meets the RAO for current and future workers	Meets the RAO	Meets the RAO
Alternative 4b	Meets the RAO	Meets the RAO	Meets the RAO for current and future workers	Meets the RAO	Meets the RAO
Alternative 5	Does not meet the RAO[b]	Meets the RAO	Does not meet the RAO[b]	Does not meet the RAO[b]	Does not meet the RAO[b]

a. RAO I: Prior to 2095, prevent current workers and the general public from ingesting SRPA groundwater contaminated by INTEC releases that exceed applicable State of Idaho groundwater quality standards (currently identified as 8 pCi/L for Sr-90, 900 pCi/L for Tc-99, 1 pCi/L for I-129, and 10 mg/L for nitrate measured as nitrogen); a cumulative excess cancer risk from all carcinogens of 1 in 10,000; or hazard index (HI) of 1.

RAO II: In 2095 and beyond, ensure that concentrations of all contaminants in SRPA groundwater contaminated by INTEC releases do not exceed State of Idaho groundwater quality standards, a cumulative excess cancer risk from all carcinogens of 1 in 10,000, or HI of 1.

RAO III: Prevent external exposure to current and future workers inside the tank farm boundary to Cs-137 contaminated alluvium in the top 4 ft of soil, including biotic transport, that would exceed an excess cancer risk of 1 in 10,000.

RAO IV: Prevent external exposure to current workers at Sites CPP-15 and CPP-58 to Cs-137 contaminated alluvium in the top 4 ft of soil that would exceed an excess cancer risk of 1 in 10,000.

RAO V: Prevent internal exposure to Cs-137 and Sr-90 inside the tank farm boundary that would exceed an ecological hazard quotient of 10 for an individual contaminant and a total HI of 10.

b. Alternative 5 would meet the RAO when implemented in combination with other alternatives.

Table 6-2. Summary of comparative analysis of OU 3-14 alternatives.

	Threshold Criteria		Primary Balancing Criteria				
Alternative	Overall Protection of Human Health and the Environment	Compliance with ARAR and TBC Requirements	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-term Effectiveness	Implementability	Total Project Cost (million) (Net Present Value in FY 2006 Dollars)
Alternative 1	Protective of human health and the environment using existing institutional controls through 2095. Not protective beyond 2095.	Complies with the ARARs and TBCs during the institutional control period. Does not comply beyond 2095.	No long-term effectiveness or permanence.	No treatment.	Highly effective. Risks are eliminated during institutional control period.	Readily implemented, because it only involves continuing existing institutional controls.	3.29
Alternative 2a	Soil and groundwater exposure risks are controlled for duration of risk.	Complies with ARARs and TBCs. Idaho Ground Water Quality Rule MCLs are attained in 2095 and after.	Provides long-term effectiveness and permanence for duration of risk by capping and removing contaminated soil. MCLs are attained in SRPA in 2095 and after.	Provides no treatment except radioactive decay.	No risks to outlying communities or environment. Risks to workers during remedy implementation and reduced to allowable levels by engineering and administrative controls.	Technically complex due to required infrastructure modifications and extent of PRCZ capping.	12.2
Alternative 2b	Soil and groundwater exposure risks are controlled for duration of risk.	Complies with ARARs and TBCs. Idaho Ground Water Quality Rule MCLs are attained in 2095 and after.	Provides long-term effectiveness and permanence for duration of risk by capping and removing contaminated soil. MCLs are attained in SRPA in 2095 and after.	Provides no treatment except radioactive decay.	No risks to outlying communities or environment. Risks to workers during remedy implementation are reduced to allowable levels by engineering and administrative controls.	Less technically complex than Alternative 2a since less infrastructure modification required as part of remedy.	9.04

Table 6-2. (continued).

Alternative	Threshold Criteria: Overall Protection of Human Health and the Environment	Threshold Criteria: Compliance with ARAR and TBC Requirements	Primary Balancing Criteria: Long-term Effectiveness and Permanence	Primary Balancing Criteria: Reduction of Toxicity, Mobility, or Volume through Treatment	Primary Balancing Criteria: Short-term Effectiveness	Primary Balancing Criteria: Implementability	Primary Balancing Criteria: Total Project Cost (million) (Net Present Value in FY 2006 Dollars)
Alternative 3a	Soil and groundwater exposure risks are controlled for duration of risk.	Complies with ARARs and TBCs. Idaho Ground Water Quality Rule MCLs are attained in 2095 and after.	Provides long-term effectiveness and permanence for duration of risk by capping and removing contaminated soil. MCLs are attained in SRPA in 2095 and after.	Provides no treatment except radioactive decay.	No risks to outlying communities or environment. CPP-31 removal remedy has lowest short-term effectiveness; highest risks of worker exposures during remedy implementation.	Very technically complex due to required infrastructure modifications, remote retrieval of large fraction of CPP-31 soil, and extent of PRCZ capping. CPP-31 removal is moderately implementable. Limited commercial availability of remote excavation services.	43.1
Alternative 3b	Soil and groundwater exposure risks are controlled for duration of risk.	Complies with ARARs and TBCs. Idaho Ground Water Quality Rule MCLs are attained in 2095 and after.	Provides long-term effectiveness and permanence for duration of risk by capping and removing contaminated soil. MCLs are attained in SRPA in 2095 and after.	Provides no treatment except radioactive decay.	No risks to outlying communities or environment. CPP-31 removal remedy has lowest short-term effectiveness; highest risks of worker exposures during remedy implementation.	Less technically complex than Alternative 3a since less infrastructure modification would be required as part of remedy.	27.5

Table 6-2. (continued).

	Threshold Criteria		Primary Balancing Criteria				
Alternative	Overall Protection of Human Health and the Environment	Compliance with ARAR and TBC Requirements	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-term Effectiveness	Implementability	Total Project Cost (million) (Net Present Value in FY 2006 Dollars)
Alternative 4a	Soil and groundwater exposure risks are controlled for duration of risk.	Complies with ARARs and TBCs. Idaho Ground Water Quality Rule MCLs are attained in 2095 and after.	Provides long-term effectiveness and permanence for duration of risk by capping, removing, and treating contaminated soil. MCLs are attained in SRPA in 2095 and after.	In situ grouting would immobilize fraction of Sr-90 remaining in soil inside tank farm boundary.	No risks to outlying communities or environment. CPP-31 in situ grouting has lower risks of worker exposures during remedy implementation than excavating soil.	Very technically complex due to required infrastructure modifications and extent of PRCZ capping. CPP-31 in situ grouting is technically complex due to subsurface infrastructure, difficulty in monitoring effectiveness. Commercial jet grouting services are available.	16.1
Alternative 4b	Soil and groundwater exposure risks are controlled for duration of risk.	Complies with ARARs and TBCs. Idaho Ground Water Quality Rule MCLs are attained in 2095 and after.	Provides long-term effectiveness and permanence for duration of risk by capping, removing, and treating contaminated soil. MCLs are attained in SRPA in 2095 and after.	In situ grouting would immobilize fraction of Sr-90 remaining in soil inside tank farm boundary.	No risks to outlying communities or environment. CPP-31 in situ grouting has lower risks of worker exposures during remedy implementation than excavating soil.	Less technically complex than Alternative 4a since less infrastructure modification would be required as part of remedy.	11.3

Table 6-2. (continued).

	Threshold Criteria		Primary Balancing Criteria				
Alternative	Overall Protection of Human Health and the Environment	Compliance with ARAR and TBC Requirements	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-term Effectiveness	Implementability	Total Project Cost (million) (Net Present Value in FY 2006 Dollars)
Alternative 5	Groundwater exposure risks are eliminated in 2095 and after. Not applicable for reducing soil exposure risks.	Idaho Ground Water Quality Rule MCLs are attained in 2095 and after. Complies with ARARs and TBCs specific for groundwater pump and treat.	Provides long-term effectiveness and permanence for duration of groundwater risk by removing Sr-90. MCLs are attained in SRPA in 2095 and after. Pumping is required until 2123.	Mobility and volume of Sr-90 in SRPA reduced. Relatively minor amounts of Sr-90 removed, treated and disposed of.	No risks to outlying communities or environment. Low risks to workers during implementation and operation, controlled through engineering and administrative controls.	Technically and administratively implementable. Technologies are demonstrated and commercially available.	1.42

ARAR = applicable or relevant and appropriate.
TBC = to be considered.

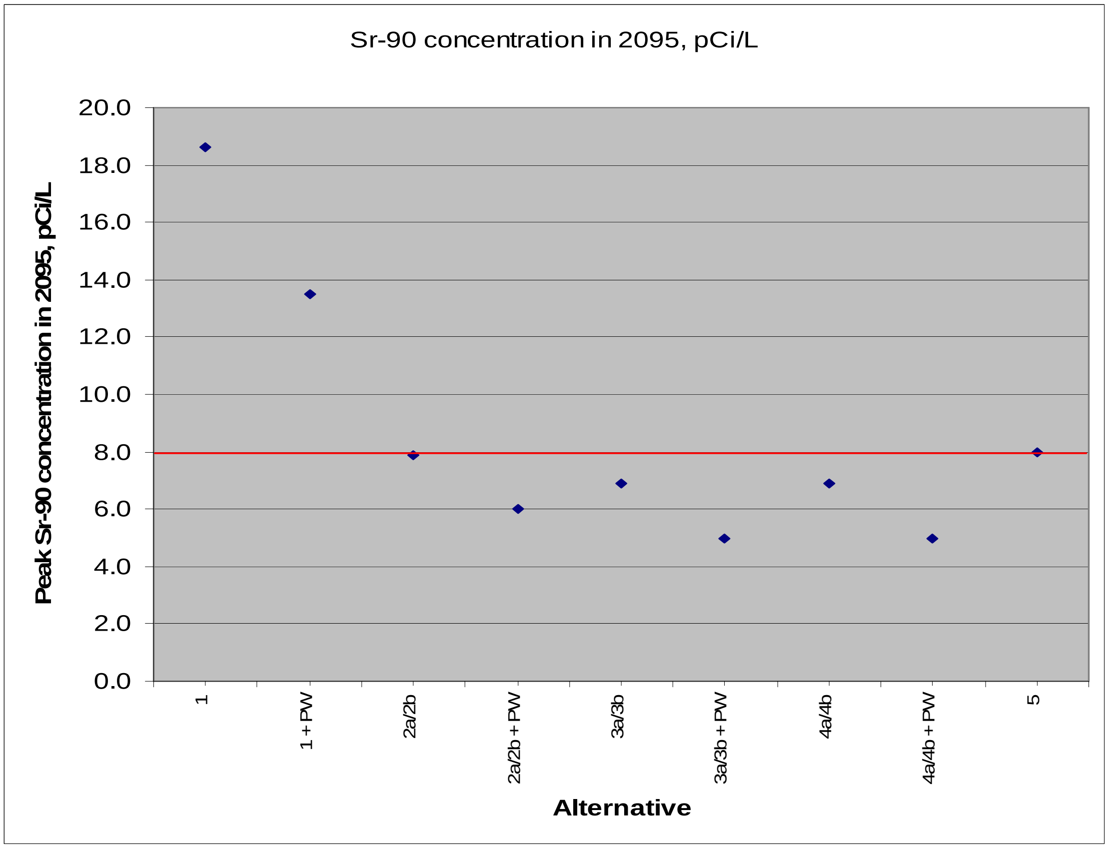

Figure 6-1. Estimated 2095 peak Snake River Plain Aquifer Sr-90 concentrations for OU 3-14 alternatives. The MCL is shown in red. PW = perched water (OU 3-13 Group 4) remedies included.

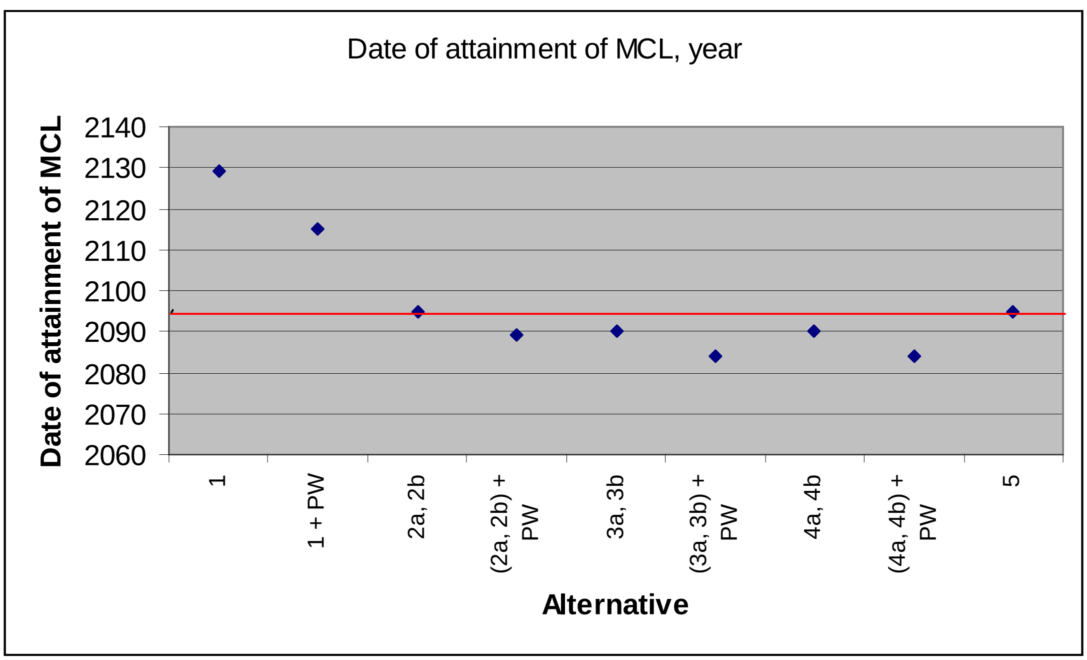

Figure 6-2. Estimated date of attainment of Sr-90 MCL in the Snake River Plain Aquifer for OU 3-14 alternatives. 2095 is shown in red. PW = perched water (OU 3-13, Group 4) remedies included.

Implementation of a final evapotranspiration (ET) cap with a capillary/biobarrier on the central tank farm in 2012, as for Alternatives 2a, 3a and 4a, vs. 2035, as for Alternatives 2b, 3b and 4b, would have no effect on attainment of RAO II, if the interim low-permeability asphalt cap was maintained to provide adequate infiltration control. Removing or immobilizing residual Sr-90 as for Alternatives 3a/3b and 4a/4b, respectively, would have a relatively minor effect on attainment of RAO II, reducing the 2095 peak Sr-90 concentration by potentially 1 pCi/L and the time of attainment of the MCL by 5 years, relative to capping alone. Removing or immobilizing residual Sr-90 in 2012, as for Alternatives 3a and 4a, versus 2035, as for Alternatives 3b and 4b, would have no significant effect on attainment of RAO II.

Alternative 1 meets RAO III for current workers only and RAO IV, because active institutional controls are assumed to end in 2095. As stated in Section 1, DOE will not rely on institutional controls alone as a sole remedy after 2095; therefore, Alternative 1 does not meet RAO III after 2095. Alternatives 2a, 2b, 3a, 3b, 4a, and 4b meet RAOs III and IV equally well, by maintaining institutional controls through 2095 and by removing and capping contaminated soil. Alternative 5 does not meet RAOs III and IV; however, Alternative 5 is a groundwater remedy that would only be implemented after a remedy for soil exposure risks had already been implemented.

Alternative 1 does not meet RAO V, because institutional controls, operation and maintenance (O&M), and monitoring were assumed to not prevent exposures to ecological receptors. Alternatives 2a, 2b, 3a, 3b, 4a, and 4b would meet RAO V equally well by removing and capping contaminated soil. Alternative 5 would not meet RAO V; however, Alternative 5 is a groundwater remedy that would only be implemented after a remedy for soil exposure risks had already been implemented.

6.1.2 Compliance with ARARs

A summary discussion of compliance with ARARs is provided in Table 6-2. ARARs for each alternative were identified in Section 5. Alternative 1 would meet all Clean Air Act (42 USC § 7401 et seq.) and Idaho air regulations identified in Table 5-1 for soil institutional controls and monitoring through administrative controls. DOE Order 5400.5 applies only during the institutional control period and would be met through administrative controls restricting public access. Alternative 1 would not meet Idaho Ground Water Quality Rules after 2095, because Sr-90 concentrations in the SRPA would exceed MCLs.

Alternatives 2a, 2b, 3a, 3b, 4a, and 4b would all meet soil removal and disposal ARARs identified in Section 5. Clean Air Act and Idaho air regulations would be met during remediation activities through administrative and engineering controls. DOE Order 5400.5 would be met by administrative and engineering controls during soil excavation and cap construction. Resource Conservation and Recovery Act (RCRA) hazardous waste determination rules for secondary wastes generated during remediation would be met by appropriate characterization prior to Idaho CERCLA Disposal Facility (ICDF) disposal or an equivalent facility after ICDF closure. Completing final remedy implementation by 2012, as for Alternatives 2a, 3a, and 4a, versus completing phased remedy implementation by 2035, as for Alternatives 2b, 3b, and 4b, would have no effect on attainment of ARARs.

Alternative 1 would not meet Idaho Ground Water Quality Rules in 2095, based on groundwater modeling predictions. Alternatives 2a, 2b, 3a, 3b, 4a, 4b, and 5 would meet Idaho Ground Water Quality Rules in 2095, based on groundwater modeling predictions.

Idaho Department of Water Resources rules for well construction standards and for injection wells would be met for Alternative 5 by design and construction to requirements developed during remedial design. Clean Air Act and Idaho air regulations and DOE Order 5400.5 would be met during construction and operation of the groundwater pump and treat system through administrative and engineering controls identified in the remedial design/remedial action (RD/RA) work plan. RCRA hazardous waste determination rules for secondary wastes generated during remediation would be met by appropriate characterization prior to disposal at an ICDF-equivalent facility.

6.2 Balancing Criteria

OU 3-14 alternatives are compared with respect to the balancing criteria in the following discussion. The primary balancing criteria to which relative advantages and disadvantages of the alternatives are compared include the following:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume through treatment
- Short-term effectiveness
- Implementability
- Cost.

The first balancing criterion assesses the ability of the alternative to remain effective for the duration of risk. The second balancing criterion addresses the statutory preference for treatment as a principal element of the remedy and the bias against off-Site land disposal of untreated material. Together with the third and fourth criteria, they form the basis for determining the general feasibility of each potential remedy. The final criterion addresses whether the costs associated with a potential remedy are proportional to its overall effectiveness, considering both the cleanup period and O&M requirements during and following cleanup. Therefore, it can be determined whether a potential remedy is cost-effective relative to others. Key tradeoffs among alternatives will most frequently relate to one or more of the balancing criteria.

6.2.1 Long-term Effectiveness and Permanence

Alternative 1 would provide no long-term effectiveness or permanence, because no physical controls would be implemented, other than the Tank Farm Interim Action (TFIA) asphalt surfaces. The TFIA asphalt surfaces are assumed to require relatively frequent repair and sealing and are assumed to not limit infiltration into CPP-31 soil after 2095. The surface water controls would not be effective after 2095. The existing asphalt surface covering would not provide an adequate surface barrier to prevent exposures to future workers after 2095.

Alternatives 2a and 2b would provide long-term effectiveness and permanence for contaminated soil by removing and disposing of some soil in the ICDF, an engineered containment facility, followed by capping with low-permeability asphalt, and capping the remainder of the tank farm with an ET cover with a capillary/biobarrier. Alternatives 3a and 3b would provide the most long-term effectiveness and permanence by removing and disposing of CPP-31 soil prior to capping. Alternatives 4a and 4b would provide long-term effectiveness and permanence by grouting CPP-31 in situ prior to capping. However, grouting would not be completely effective. Completing final remedy implementation by 2012, as for Alternatives 2a, 3a, and 4a, versus completing phased remedy implementation by 2035, as for Alternatives 2b, 3b, and 4b, would have no effect on long-term effectiveness and permanence.

Alternatives 2a, 2b, 3a, 3b, 4a, and 4b would provide long-term, permanent, and effective remedies for the SRPA, because MCLs would be met after 2095. Alternative 5 would provide long-term effectiveness and permanence for the SRPA by removing Sr-90 from extracted groundwater by ion exchange and disposing of the ion exchange resins in an ICDF-equivalent facility.

6.2.2 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 would not implement treatment and would not accomplish any reduction of Cs-137 or Sr-90 toxicity, mobility, or volume except through natural radioactive decay. Alternatives 4a and 4b would implement in situ grouting at CPP-31, thereby reducing mobility of most of the Sr-90 present in soil at OU 3-14.

Alternatives 2a, 2b, 3a, and 3b would not use treatment. However, toxicity and mobility of Sr-90 would be lowered by reducing infiltration that drives downward migration from contaminated perched water to the SRPA.

SRPA pumping and treatment implemented as part of Alternative 5 would reduce the mass and mobility of Sr-90 and the volume of contaminated water until 2095. However, very small amounts, i.e., less than 0.1 Ci, would be recovered. Secondary wastes, including spent ion exchange resins, regenerant, and treated groundwater, would be produced, as discussed in Section 5.

6.2.3 Short-term Effectiveness

No added risks to the public or the environment would result from implementing any of the alternatives; therefore, only worker risks during remedy implementation are discussed. Alternative 1 has the best short-term effectiveness, because existing institutional controls, TFIA O&M, and monitoring could be continued with no added risks or hazards to workers. Soil removal and cap construction implemented as part of Alternatives 2a, 2b, 3a, 3b, 4a, and 4b would have incrementally higher risks to workers, but they could be mitigated by INL Site work controls and physical controls.

Short-term effectiveness for Alternative 2b would be essentially the same as for Alternative 2a. Construction of a low-permeability asphalt cover on the central tank farm as part of phased remedy implementation would not increase risks to workers, the public, or the environment.

Alternatives 4a and 4b would have increased chances of worker exposures and injuries due to production of radioactive drill cuttings and grout returns and use of high-pressure fluids. Mitigating risks and hazards would require significant administrative and engineering controls. Gamma radiation exposures from drill cuttings and grout returns under Alternative 4b would be lower than for Alternative 4a because an additional 23 years of radioactive decay of Cs-137 would reduce gamma radiation levels significantly.

Alternatives 3a and 3b would likely have the highest worker direct radiation exposures and would require more substantive administrative and engineering controls, including shielding and a work enclosure. Even if all worker exposures were controlled to facility limits by using shielding, reducing exposure times and increasing the numbers of workers, the total occupational exposures for removal of CPP-31 soil, calculated as total person-rem, would be higher for Alternatives 3a and 3b than for any other alternative. Exposures under Alternative 3b would be somewhat lower than for Alternative 3a since an additional 23 years of radioactive decay of Cs-137 would reduce gamma radiation levels significantly.

Any additional risks resulting from groundwater pumping and treatment implemented as part of Alternative 5 could be readily mitigated by INL Site work controls and engineering controls.

6.2.4 Implementability

Alternative 1 would be the most readily implementable alternative, because it only involves continuing existing institutional controls, TFIA O&M, and monitoring. Soil removal from the north tank farm perimeter for Alternatives 2a, 2b, 3a, 3b, 4a, and 4b is highly implementable, because relatively low exposures would be encountered, and because of the availability of the ICDF for disposal. Paving the PRCZ with low-permeability asphalt is technically implementable; however, achieving the required positive drainage over the entire area would require regrading in some areas as well as additional lined drainage ditches and potentially at least one additional lift station.

Capping the central tank farm with an ET cover with a capillary/biobarrier by 2012, as for Alternatives 2a, 3a, and 4a, is technically complex, because of the infrastructure constraints discussed in Sections 4 and 5. Decontamination and decommissioning of existing buildings and construction of retaining walls as part of remedy implementation would greatly reduce the technical implementability of these alternatives. Capping the central tank farm with an ET cover with a capillary/biobarrier by 2035, as for Alternatives 2b, 3b, and 4b, is much more feasible, since infrastructure constraints would have been removed by the decontamination and decommissioning program prior to capping.

CPP-31 soil removal for Alternatives 3a and 3b also has relatively low implementability. This is because of the high direct radiation exposures that would be encountered, which would require remote retrieval inside an enclosure and specialized equipment and services with limited availability, and the required depth of retrieval, which would require shoring and access ramps. Alternative 3b is more technically feasible than Alternative 3a, since infrastructure constraints would be reduced by 2035.

In situ grouting for Alternatives 4a and 4b also has relatively low implementability due to the extensive subsurface infrastructure, potential for worker exposures and injury, and requirements for specialized equipment and services that have limited availability. Alternative 4b is more technically feasible than Alternative 4a, since infrastructure constraints would be reduced by 2035.

Groundwater pumping and treatment implemented under Alternative 5 is complex but would be technically and administratively implementable. The ICDF would not be available for disposal of secondary wastes during the pumping period; however, it was assumed that an equivalent facility would be available when needed.

6.2.5 Cost

Total project costs are listed in Table 6-2.

6.3 Summary

Six alternatives (Alternatives 2a, 2b, 3a, 3b, 4a, 4b) would meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. The combination of low-permeability asphalt and an ET cover with a capillary/biobarrier implemented for these alternatives would effectively control infiltration and thereby attain the Sr-90 MCL in the SRPA by 2095, reduce direct radiation exposures to future workers, and prevent biotic intrusion and transport of contaminants to the surface. Removing or immobilizing residual Sr-90 in alluvial soil at CPP-31, as for Alternatives 3a/3b and 4a/4b, respectively, would not significantly improve overall protection of human health and the environment or compliance with ARARs, compared to containment alone, as for Alternatives 2a/2b.

Low-permeability asphalt pavement implemented to control infiltration for Alternatives 2a, 2b, 3a, 3b, 4a, and 4b, would require maintenance and periodic replacement until the Sr-90 MCL was attained in the SRPA in about 2129. The ET cover with a capillary/biobarrier implemented for the same alternatives, to control infiltration and protect future workers, would function effectively with no operation and maintenance after 2095, until the worker Cs-137 soil preliminary remediation goal (PRG) was attained in about 2234.

Alternative 5 would only be implemented after Alternative 2a, 2b, 3a, 3b, 4a, or 4b had already been implemented and had been determined through SRPA monitoring to not be sufficiently protective of the aquifer. Alternative 5, in combination with Alternative 2a, 2b, 3a, 3b, 4a, or 4b, would meet all threshold criteria.

Alternative 1 would meet RAOs I and IV only, by maintaining institutional controls through 2095. Alternative 1 would not meet the Idaho Ground Water Quality Rule or DOE Order 5400.5, “Radiation Protection of the Public and the Environment,” after 2095.

None of the alternatives would result in short-term risks to the public or the environment during remedy implementation. Alternatives 3a/3b and 4a/4b, which incorporate source removal or in situ treatment, would have the lowest short-term effectiveness because workers could be exposed to high radiation fields during soil removal or in situ treatment, respectively. Alternatives 2a and 2b would have better short-term effectiveness since relatively lower amounts of lower-activity soil would be excavated, and worker exposures during capping would be relatively low. Worker exposures could occur during O&M of the groundwater treatment system for Alternative 5, but these could be reduced to allowable levels by engineering and administrative controls. Alternative 1 would have the best short-term effectiveness.

Phased remedy implementation, as for Alternatives 2b, 3b, and 4b, would be much more technically implementable than completing construction of the final remedy by 2012, as for Alternatives 2a, 3a, and 4a. Continuing INTEC operations in and around the tank farm would greatly reduce implementability of a final remedy before 2035, the assumed date when northern INTEC operations will end. Alternatives 2b, 3b, and 4b would be equivalent to Alternatives 2a, 3a, and 4a with respect to threshold criteria but would be much more implementable and would have higher short-term effectiveness.

Total project cost expressed as net present value in FY 2006 dollars, for alternatives that meet the threshold criteria, ranges from $9.0M for Alternative 2b to $44.5M for the combination of Alternatives 3a and 5.

6.4 References

42 USC § 7401 et seq., 1990, *Clean Air Act*, U.S. Environmental Protection Agency, 1990.

DOE O 5400.5, Change 2, 1993, “Radiation Protection of the Public and the Environment,” U.S. Department of Energy, January 7, 1993.